
Autodesk® PowerMill® 2018

Getting Started



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Introduction

PowerMill is the world's leading specialist NC CAM software for manufacturing complex shapes typically found in the toolmaking, automotive, and aerospace industries.

Key features:

- Wide range of milling strategies which include high-efficiency roughing, high-speed finishing, and 5-axis machining techniques.
- Fast calculation times for toolpath creation and postprocessing.
- Powerful editing tools to ensure optimum performance on the machine tool.

This **Getting Started** guide provides step-by-step instructions that highlight some of the features of this versatile software.



It is assumed that you know how to operate your machine tool and how to select suitable tools and cutting conditions. If you are unsure about any aspect of operating your machine tool, consult an expert or seek advice from your machine tool supplier.



The machining parameters used in the examples in this guide illustrate the effects of different commands and options in PowerMill. The values given are not necessarily suitable for cutting on a CNC machine. If you wish to machine any parts based on the examples given, carefully review and adjust the parameters to ensure safe cutting conditions.

Setting up your working directories

To make project management easier, it is recommended that you define a home folder and default directory paths before starting any work with PowerMill:

- Setting up a Home folder for user-defined macros (see page 2).
- Specifying PowerMill default directory paths (see page 3).
- PowerMill temporary file area (see page 4).

Setting up a Home folder for user-defined macros

PowerMill checks for the value defined in the Windows environment variable **Home** for directions to the user-defined macros folder. Decide where you want the **Home** environment variable to point to, for example, **E:\PowerMill_Projects**, and set up a Windows environment variable:

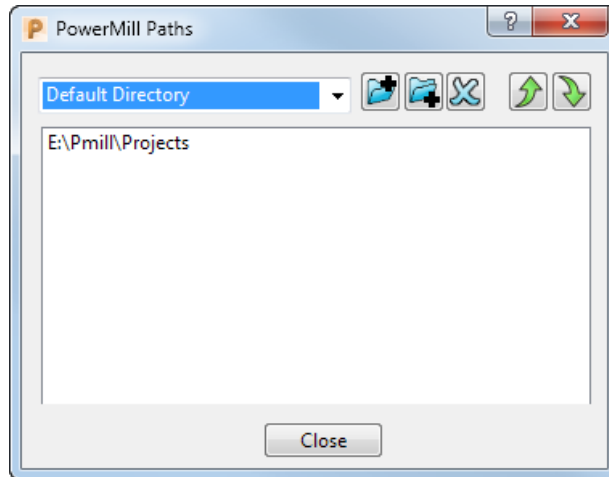
- 1 Open **Windows Control Panel** and click **System > Advanced system settings**. This displays the **System Properties** dialog.
- 2 Click the **Advanced** tab.
- 3 Click **Environment Variables**.
- 4 To add a new variable name and value, click **New** to display the **New User Variable** dialog.
 - a In the **Variable Name** field, enter **Home**.
 - b In the **Variable Value** field, enter the path where you want your home folder to be. For example, **E:\PowerMill_Projects**.
- 5 Click **OK** in all open dialogs to save changes and close them.
- 6 Create a folder called **pmill** inside the **Home** directory. For example, **E:\PowerMill_Projects\pmill**.

When user-defined macros are created or called, PowerMill automatically locates the user-created macros in this folder.

Specifying PowerMill Default Directory paths

To specify the **Default Directory** path in PowerMill:

- 1 Click **File** tab > **Options** > **Customise Paths** This displays the **PowerMill Paths** dialog.
- 2 Select **Default Directory** from the drop-down list.



- 3 To add a **Default Directory** path, click  and use the **Select Path** dialog to select the desired location. The path is added to the list. You can add multiple paths to the **Default Directory** list.



*You can have only one active **Default Directory** path. PowerMill enables you to add multiple paths to the **Default Directory** list to help you efficiently organise multiple projects across different folders. To change the **Default Directory** load order, select the directory path you want to change, and use the  and  buttons to promote or demote the path.*

- 4 Click **Close**.

Your default working directory is changed to the directory path you selected and all your file operations (**Open Project**, **Save Project**, **Import Model**, **Export Model**) are changed to this location.

Specifying PowerMill temporary file area

By default, PowerMill projects use the default Windows **temp** folder (defined in your **Windows System Properties**) as the temporary area.

To define a custom PowerMill temporary file area:

- 1 Right-click **My Computer**, and then click **Properties**. This displays the **System Properties** dialog.
- 2 Click the **Advanced** tab.
- 3 Click **Environment variables**.
- 4 Click **New** to add a new variable name and value.
 - a In the **Variable Name** field, enter **POWERMILL_USER_TEMPDIR**.
 - b In the **Variable Value** field, enter the path where you want your PowerMill temporary folder to be. For example, **E:\PowerMill_Projects\TemporaryFiles**.
- 5 Click **OK** in all open dialogs to save changes and close them.
- 6 Create the temporary folder in Windows to the path where you specified the variable. For example **E:\PowerMill_Projects\TemporaryFiles**.



If there are any problems with the variable you have specified, PowerMill reverts to the default Windows temporary file area.

Start and close PowerMill

To start PowerMill:

- Select **Start > All Programs > Autodesk > PowerMill > PowerMill 2018**; or,
- Double-click the PowerMill shortcut on your desktop:

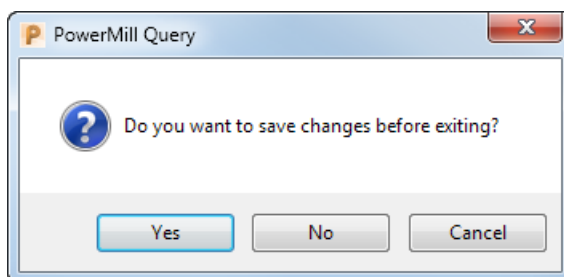


This displays the **Startup** (see page 6) window.

To exit PowerMill:

- Click **File tab > Close**; or,
- Click the **Close** button  in the top right-hand corner of the PowerMill window.

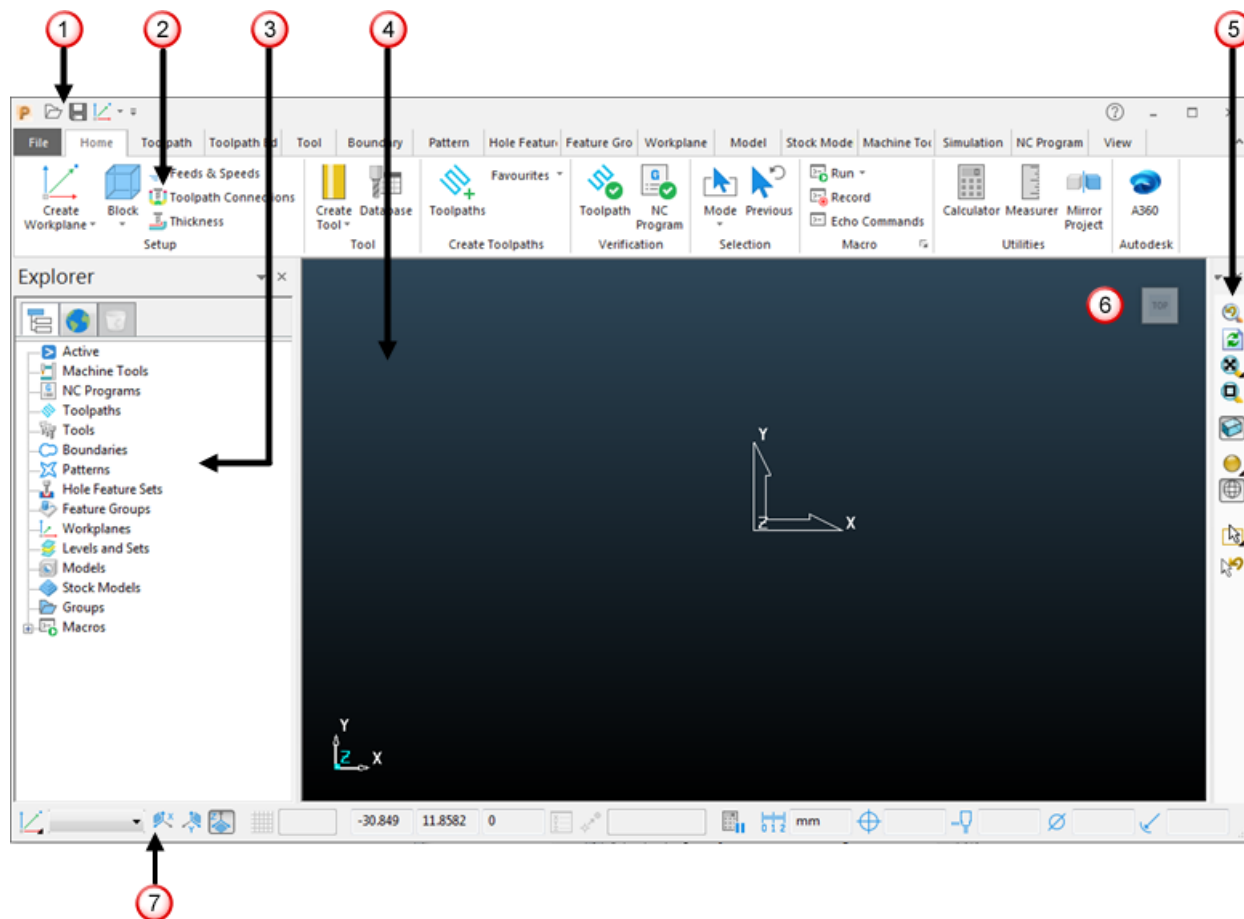
If you have not saved your project, the following message is displayed:



Click **Yes** to save the project before exiting from PowerMill.

Startup window

The following window is displayed when you start PowerMill:



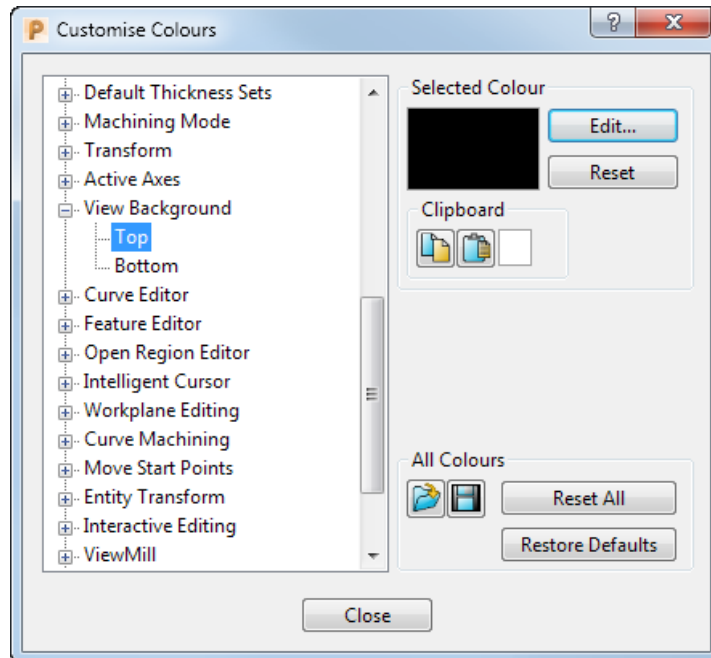
The screen is divided into the following main areas:

- ① **Quick Access Toolbar** — Enables you to quickly access frequently used ribbon commands, such as Save, without having to navigate the ribbon.
- ② **Ribbon** — A collection of tabs and panels that organise PowerMill functionality.
- ③ **Explorer (see page 8)** — Provides control over all PowerMill entities.
- ④ **Graphics window** is the working area of the screen.
- ⑤ **View toolbar** — provides quick access to common views and shading options in PowerMill. The full range of viewing options are available on the **View tab**.
- ⑥ **ViewCube** enables you to interactively orientate the contents of the graphics window.

⑦ **Status and Information toolbar** enables you to create and activate workplanes, display various preset and user-defined settings. If you hover the cursor over a button, help is displayed. The help can be, for example, a brief description of the item beneath the cursor, or information about the calculation that is in progress.



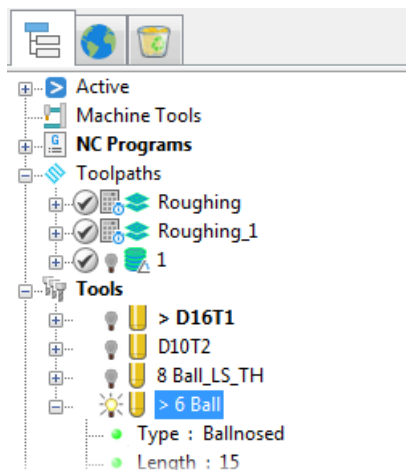
*If you want to change background colours, click **File tab > Options > Customise Colours** and choose **View Background**. You can change the **Top** and/or **Bottom** colours and **Reset** them or **Restore Defaults** if you change your mind afterwards.*



PowerMill remembers your colour selections from one session to the next.

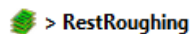
Explorer

The Explorer displays the entities used in a PowerMill project. (The term *entity* broadly refers to all entries in the Explorer.) The entities in the Explorer are grouped together by type, for example, toolpaths are grouped in the **Toolpaths** branch and tools are grouped in the **Tools** branch. Because a PowerMill project often contains a lot of entities, the Explorer uses an **Active** > system to indicate which entities have focus.



Making an entity active (shortcut)

Double-click an entity to make it active (you need to click the entity's icon and not its name). The new active entity is displayed in **bold** and preceded by an angle bracket (>).



Each branch can only have one active entity at a time.

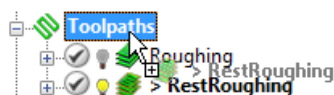
Drawing/unbarring an entity in the graphics area

You can draw or undraw entities in the graphics area. Click an entity's light bulb to specify its display setting:

-  — Entity is always undrawn.
-  — Entity is drawn only when active.
-  — Entity is always drawn.

Duplicating an entity (shortcut)

- 1 Press **Ctrl** and drag the entity onto the title of its branch (when you drag the entity, position the mouse over the entity's icon).



- 2 Release the left mouse button when  changes to .

This creates a copy of the entity with the suffix **_1**. If you duplicate the entity again the suffix is **_2** and so on.

 RestRoughing
 > RestRoughing_1

Displaying the context menus

There are two types of context menus available in the Explorer: general context menus and specific context menus. To display the context menus:

General — Right-click the title of an entity branch. The menu options are relevant to all the entities in the branch.

Specific — Right-click an individual entity. The menu options are relevant only to the entity.

Deleting an entity

Right-click the entity and select the delete menu option, for example, **Delete Toolpath**. The entity is placed in the **Recycle Bin**.

To permanently delete an entity:

- select the entity and press **Shift+Delete**; or
- right-click the entity and select the delete menu option while pressing **Shift**.



Permanently deleting entities reduces PowerMill's memory requirements.

Repositioning the Explorer pane

Like all toolbars in PowerMill, you can float and reposition the Explorer pane:

Double-click the top of the Explorer pane to float the pane and then drag it to a new position. To dock the pane on the opposite side of the window, drag the pane over the side of the window and release the left mouse button — the pane 'snaps' into position.

Unit System

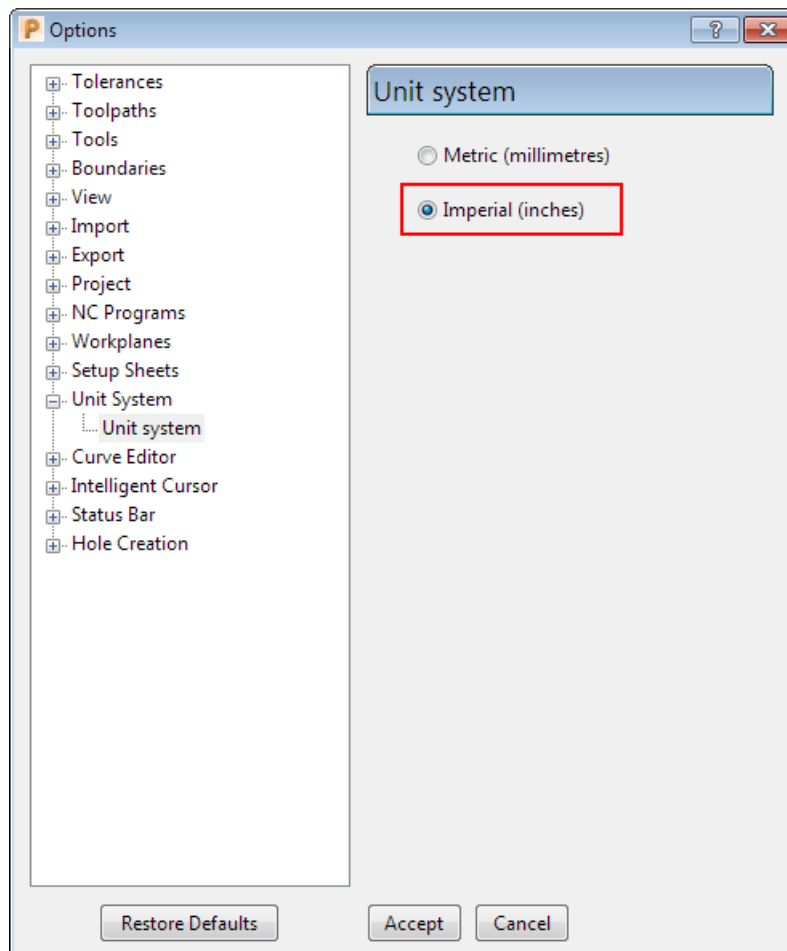
By default, PowerMill uses metric units. You can change the unit system before any project entities are created.



This guide uses metric (mm) units.

To change the default units before you start work, for example, from **Metric** to **Imperial**:

- 1 Click File tab > Options > Application Options. This displays the **Options** dialog.
- 2 Select **Unit System** and click  to expand the tree to view available options.
- 3 Select the **Unit System** sub-item. This displays the **Unit System** page.
- 4 Select **Imperial (inches)**.



- 5 Click **Accept** to save changes.



Changing the unit system automatically resets all the default values on the dialogs to match the selected unit system. PowerMill does not convert the values between the unit systems; instead, it chooses an appropriate set of default values (metric or imperial).

Accessing Help

PowerMill offers the following forms of help:

- Tooltips (see page 11)

- Context-sensitive online help (see page 11)
- Manuals (see page 12)

For more information see Using the help window.

Tooltips

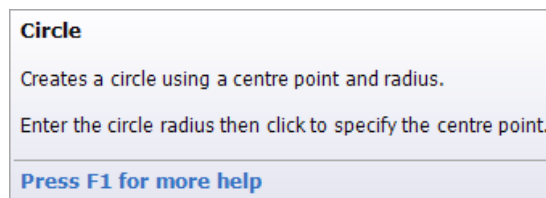
Tooltips provide information about an item in the user interface.

To display a tooltip:

- 1 Hover the cursor over an item to display its tooltip.



- 2 Continue to hover the cursor over an item to display an extended tooltip which contains additional information about that item.



You can specify how tooltips are displayed from the **Tooltips > Tooltip Options** category of the **Options** dialog.

Context-sensitive online help

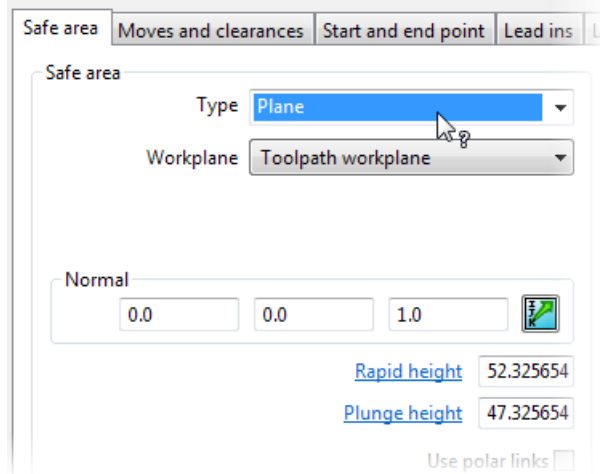
Pressing the **F1** key displays help for the area of the screen that has current focus, such as a display pane (Explorer or graphics window), a dialog, or a dialog tab. Where there is no focus, the contents page for the main **Help** is displayed, so you can navigate from there.

To display the help topic relating to an element on the main PowerMill screen (for example, a ribbon button or an Explorer entity), hold down the **Shift** key and press **F1**. When the cursor changes to , click the item of interest to open the help topic.



*If you want to cancel context-sensitive mode, press **Esc**.*

To display context-sensitive help for an item within a PowerMill dialog (such as a field or a button), click  and when the cursor changes to , click the item to open the associated help topic:



Manuals

The PowerMill manuals offer additional help.

The documents are:

- **What's New** and **Getting Started** PDFs available for download.
- Online **Reference help**, **What's New** and **Getting Started**.

Cavity mold example

This example shows how to generate and output the basic toolpaths used to machine a cavity mold.

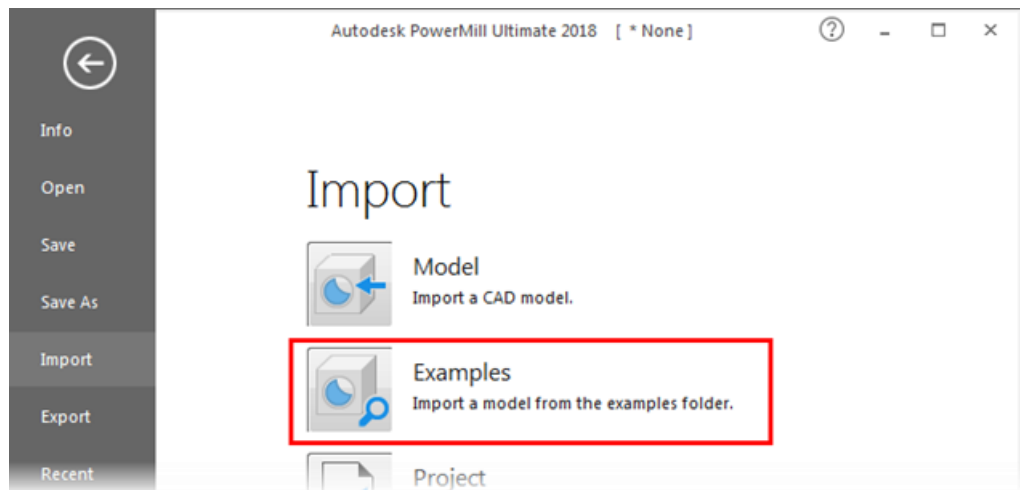
- 1 Start PowerMill (see page 5).
- 2 Load the model (see page 14).
- 3 Save the project (see page 18).
- 4 View the model and block (see page 19).
- 5 Create an NC program (see page 23).
- 6 Create, simulate, and output each toolpath:
 - **Roughing** (see page 27) — Use this toolpath to rapidly remove the majority of excess material.
 - **Rest roughing** (see page 41) — Use this toolpath to remove material which the roughing toolpath is unable to remove. The toolpath uses the same strategy as the roughing toolpath but with a smaller tool to remove additional material.
 - **Finishing** (see page 49) — Use this toolpath to machine steep and shallow areas of the part.
 - **Corner Finishing** (see page 66) — Use this toolpath to smooth areas of the part which the previous toolpaths are unable to machine, for example corners between non-tangential surfaces.

Loading the model

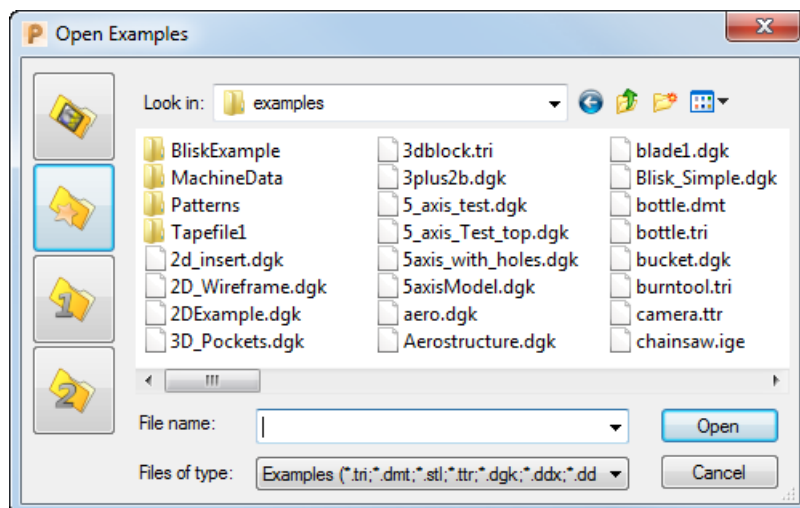
The example model is a cavity mold which is located in the [Examples](#) folder.

To load the model:

- 1 Click File tab to display the Backstage View and select Import > Examples.

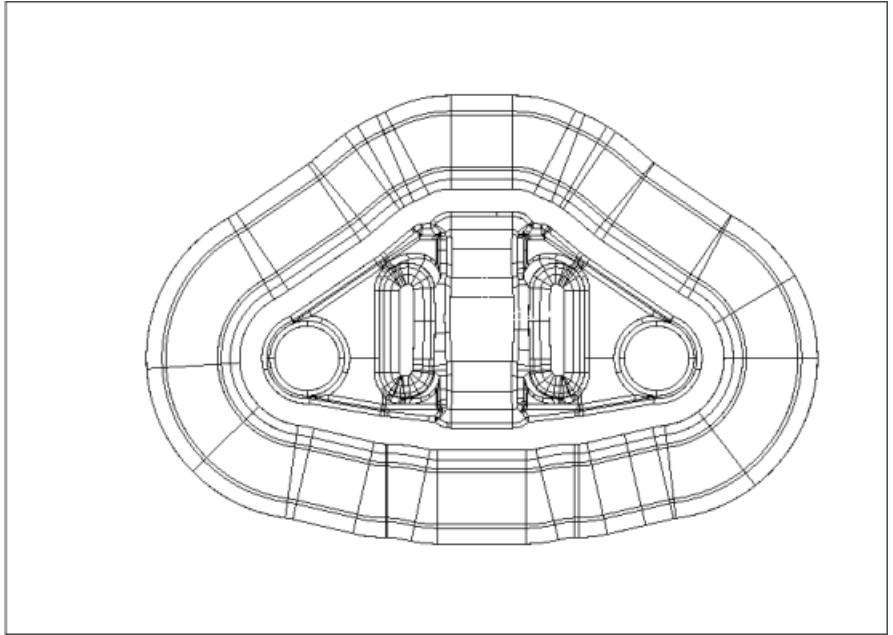


The **Open Examples** dialog is displayed, automatically opening the drive and folder where the tutorial files are installed:

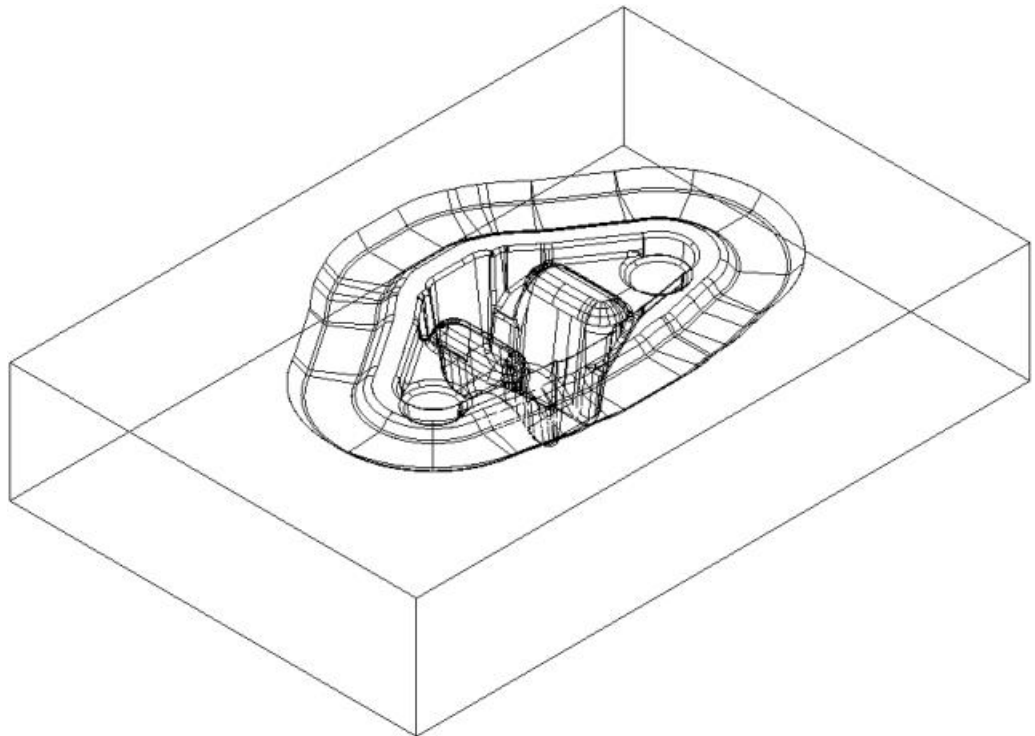


- 2 In the **Files of type** field, select ***.dgk** from the drop-down list.
- 3 Select the cavity mold called **die.dgk**, and then click **Open**.
PowerMill loads the file.

- 4 Click View tab > Navigate panel > Resize to Fit to fit the model within the display.

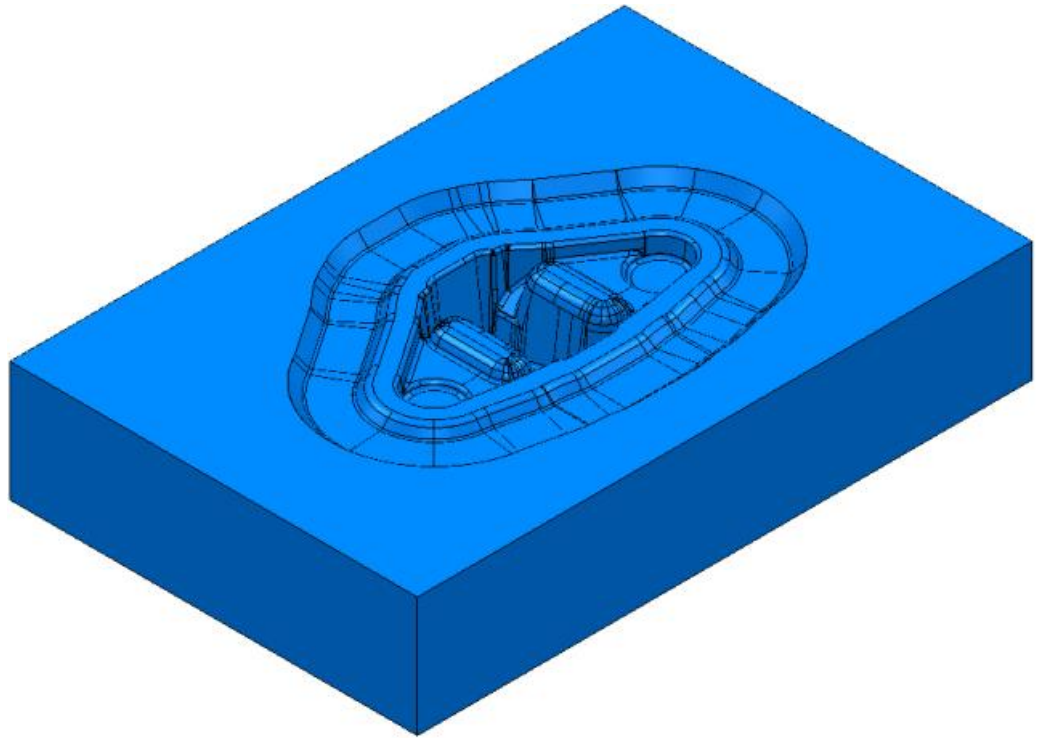


- 5 To change the display to an isometric view, click View tab > Views panel > ISO, and select an option from the menu. The model looks like this:



More information on view manipulation is provided later (see page 19).

- 6 The model is currently displayed with only the wireframe selected. To add shading, click View tab > Appearance panel > Shade > Plain.



- 7 Remove the wireframe by clicking View tab > Appearance panel > Wireframe.



*Toggle the buttons to switch between **Wireframe**, **Plain Shade**, **Wireframe and Shaded**, and **No Model** views.*

For this exercise, keep the model shaded.

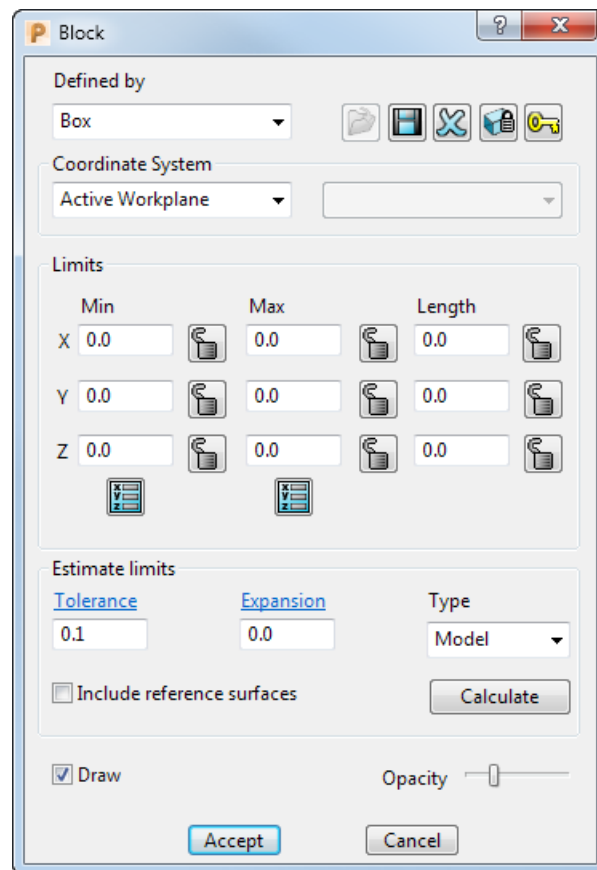
Defining the block around the die

The block defines the stock size. The part is then machined from the block. In this case, the block is a rectangular cuboid.

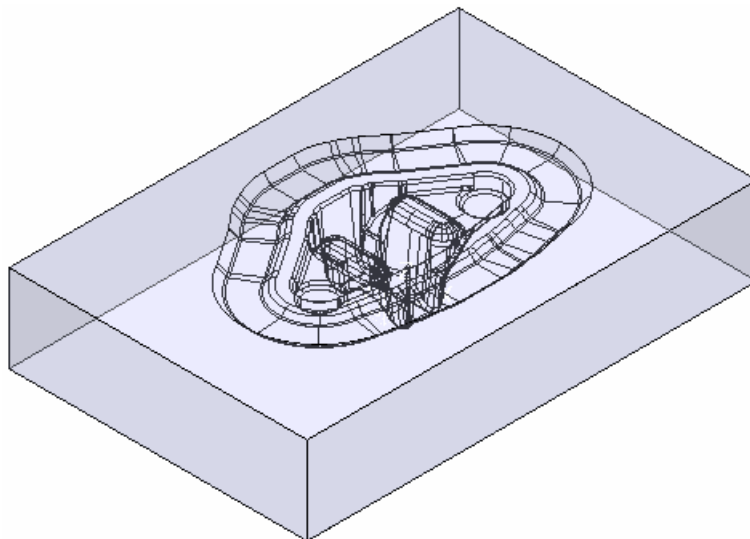
To define the block:

- 1 Click Home tab > Setup panel > Block > Block to display the **Block** dialog.
- 2 In the **Block** dialog, check that:
 - a **Defined by** is set to **Box**.
 - b **Coordinate System** is set to **Active Workplane**.
 - c In the **Estimate Limits** area, **Expansion** is set to **0** and **Type** to **Model**.

d Draw is selected.



3 Click **Calculate** to define a cuboid enclosing the die. Click **Accept** to close the dialog.



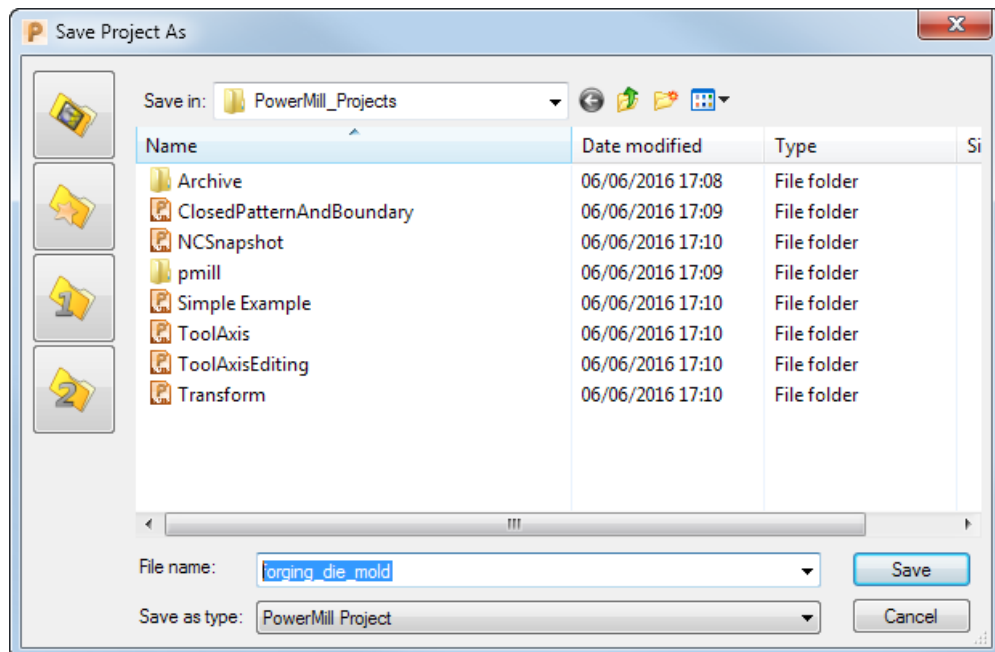
To toggle the display of the block on and off, click View tab > Appearance panel > Block.

Saving the project for the first time

PowerMill saves all the entities, together with a copy of the model, as a single project.

To save a project:

- 1 Click File tab > Save. Because you have not previously saved the project, the **Save Project As** dialog is displayed.



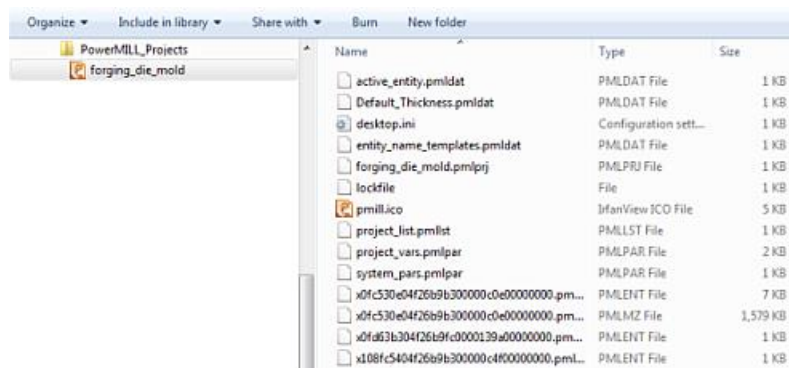
- 2 Open the directory that you created for your projects (see page 2), and enter a name for your project in the **File name** box, for example **forging_die_mold**.

- 3 Click **Save**.

The PowerMill window header displays the name of the project.

[Editable Project - forging_die_mold]

An associated file structure is created:



Do not manually edit these files because you will corrupt your data.

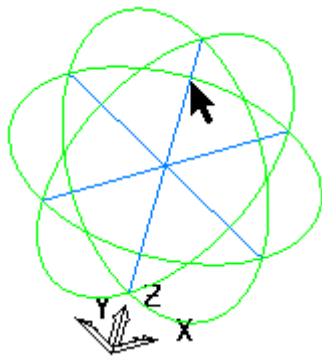


Click File tab > Save to update the saved version of the project.

Viewing the model and block

To look at a specific area of the model or block, you can either select one of the predefined views (see page 19) on the **View** tab, or use the mouse.

It is recommended that you use a three-button mouse. By holding down the middle button and moving the cursor in the graphics area, you can control the view of the model. When you move the mouse (with the middle button pressed), the trackball is displayed.



Start with the cursor in the middle of the window and press the middle mouse button, then drag the cursor up the screen. The image moves as you move the mouse.

Predefined views

There are several fixed viewing directions available from the **View** tab.



Use the **View Mode** buttons to switch between milling and turning view modes. These modes determine how the model is orientated in the graphics window.



Use the **From** options to orientate the view so the model is viewed along the X, Y, or Z axis. Hover on any of these buttons to display a 2D view toolbar which has additional view options along the primary axes.



Use the **ISO** options to change the view angle to any of the isometric views. Hover on the button to display other isometric view options.

Isometric views are often the best starting point for dynamically manipulating the view using the mouse.



Use the **Last** option to view model as previously displayed.



Use the **Refresh** option to redraw all currently displayed components, repairing any damage to the current view. This is useful if the view loses definition as items are created, modified, or deleted.



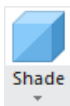
Use the **Resize to Fit** (see page 21) option to adjust the view so the entire model can be seen. Depending on the current view, PowerMill zooms in or out to achieve the new view.



Use the **Zoom** (see page 21) options to zoom in or out of the model.



Use the **Block** option to show or hide the block.



Use the **Shade** option to show or hide the shaded representation of the model.

Expand the **Shade** menu to show the other shading options..



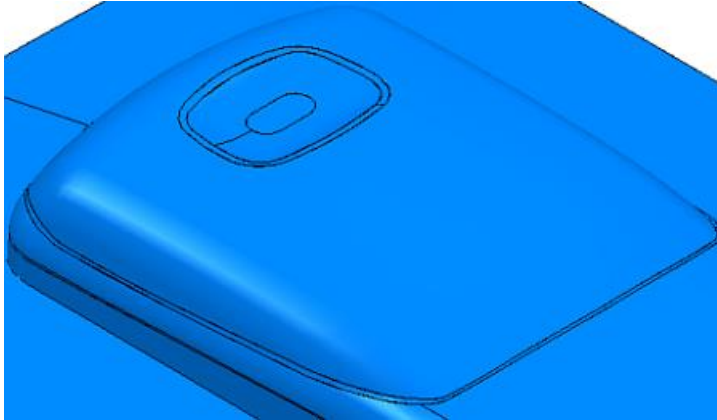
Use the **Wireframe** option to show or hide the wireframe representation of the model.

Zoom

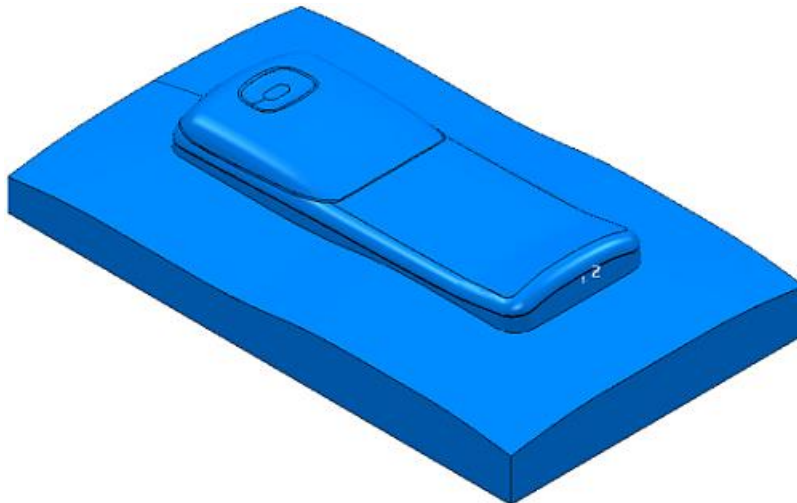
Use the options on the View tab > Navigate panel to resize the model.

- **Resize to Fit** — Use this option to adjust the view to see the entire model.

It converts this:



to this:



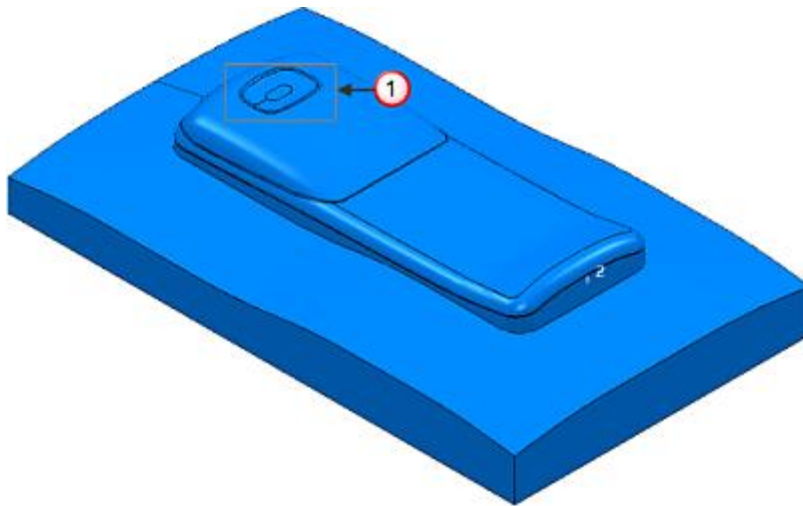
This zooms in or out as required. So, it also zooms a microscopic image on the screen to one that just fits inside the window.



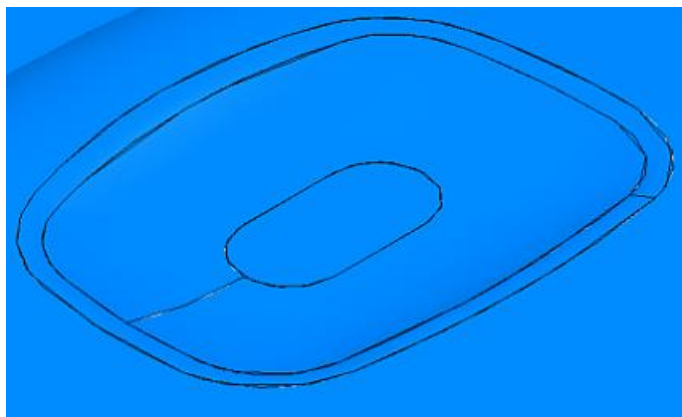
If you cannot see your model, click View tab > Navigate panel > Resize to Fit to centre the model at the middle of the screen.

- **Zoom:**
 - **Zoom to Box** — Use the option to zoom in to a specific area of the image. Click and then use the left mouse button to drag a zoom box over a section of the model. PowerMill zooms in to the boxed area.

It converts this:



into this:



① Zoom box

- **Zoom In** — Use this option to zoom in to the model. Click repeatedly until desired view is achieved. This zooms the model about the centre of the graphics window.
- **Zoom Out** — Use this option to zoom out from the model. Click repeatedly until desired view is achieved. This zooms the model about the centre of the graphics window.



*You can also resize a model by holding down the **Ctrl** key and the middle (or right) mouse button, and then dragging the mouse up to **Zoom In** or down to **Zoom Out**.*

Panning

You can **Pan** the model by holding down the **Shift** key and the middle (or right) mouse button, and then dragging the mouse in the direction in which you want to move the image.

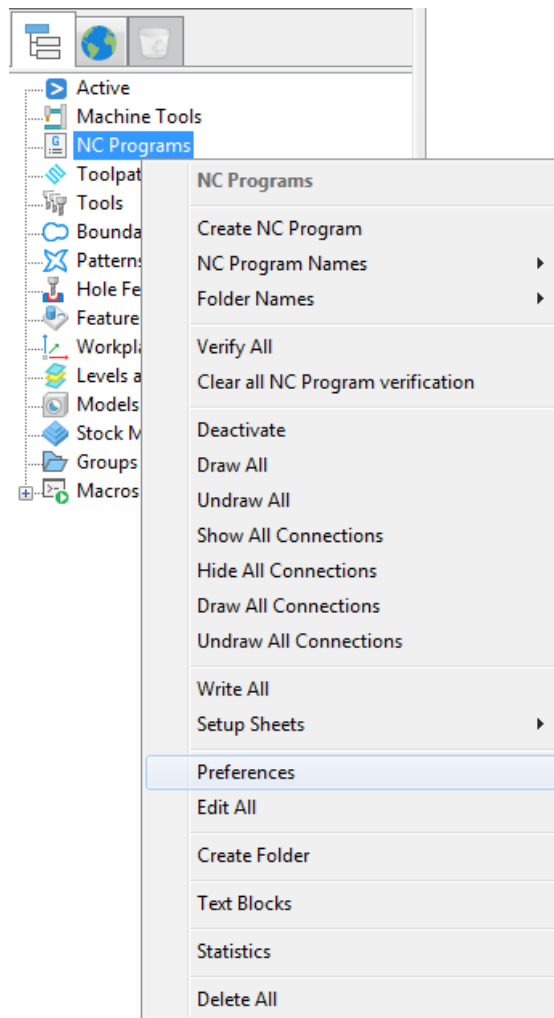
NC program

An NC program contains the commands and output settings that specify how the machine controller machines the part.

It is advisable to create an NC program, and set the preferences for it before generating any toolpaths. However, it's just as easy to add generated toolpaths to the NC programs later (see page 76).

Setting NC program preferences

- 1 In the Explorer, right-click **NC Programs** and select **Preferences**.



This displays the **NC Preferences** dialog.

- 2 On the **Output** tab of the **NC Preferences** dialog, select **Use Project - On** to write the NC program file into the PowerMill project folder.

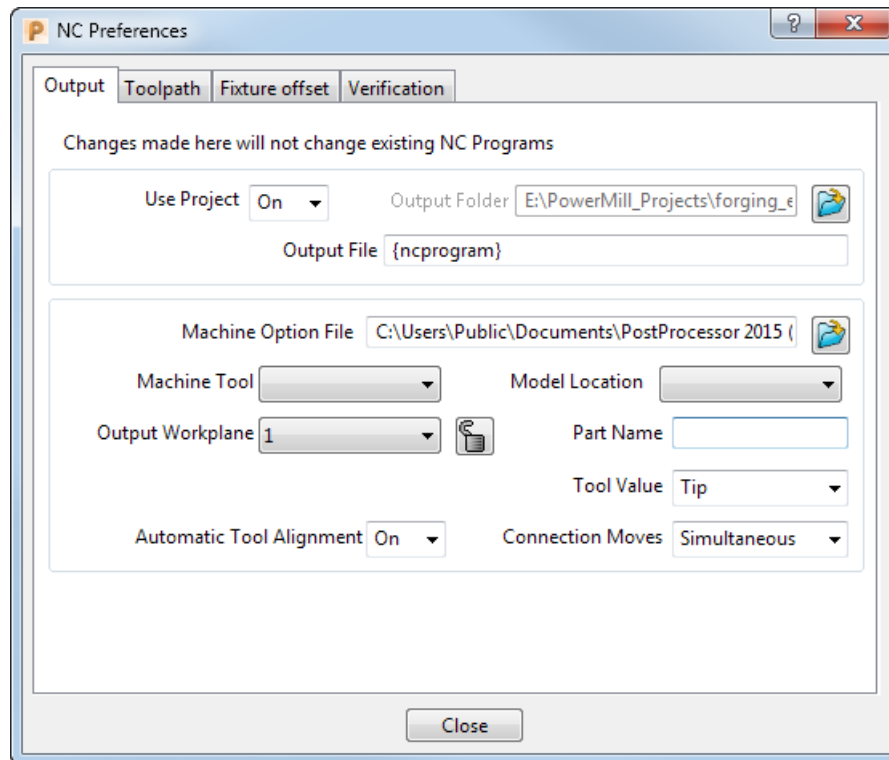


Select **Use Project - Off** to write the NC program file to a different folder. You need to specify it in the **Output Folder** box.

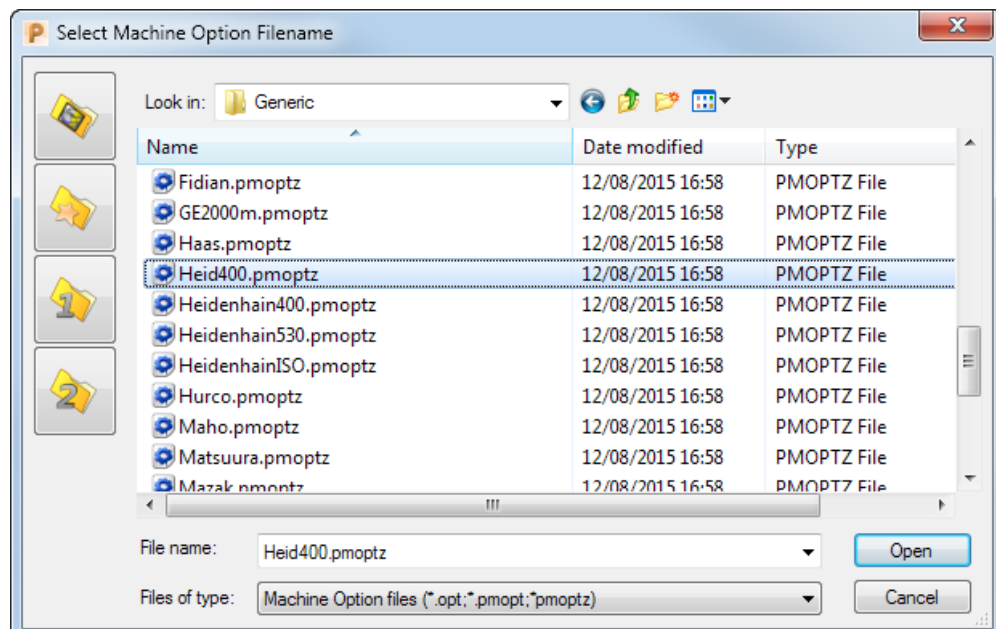
- 3 Enter the output file name to be used by default in the **Output File** box.



*The variable **%[ncprogram]** gives the output file the same name as the NC program. You can add your file name to this variable.*



- 4 Click  (next to the **Machine Option File** box) to open the **Select Machine Option Filename** dialog.
- 5 Browse to the folder where the option files are stored, select the machine option file (in this case **Heid400.pmoptz**) and click **Open**.



This closes the **Select Machine Option Filename** dialog and returns you to the **NC Preferences** dialog.

- 6 Click **Accept** to save your changes and close the dialog.

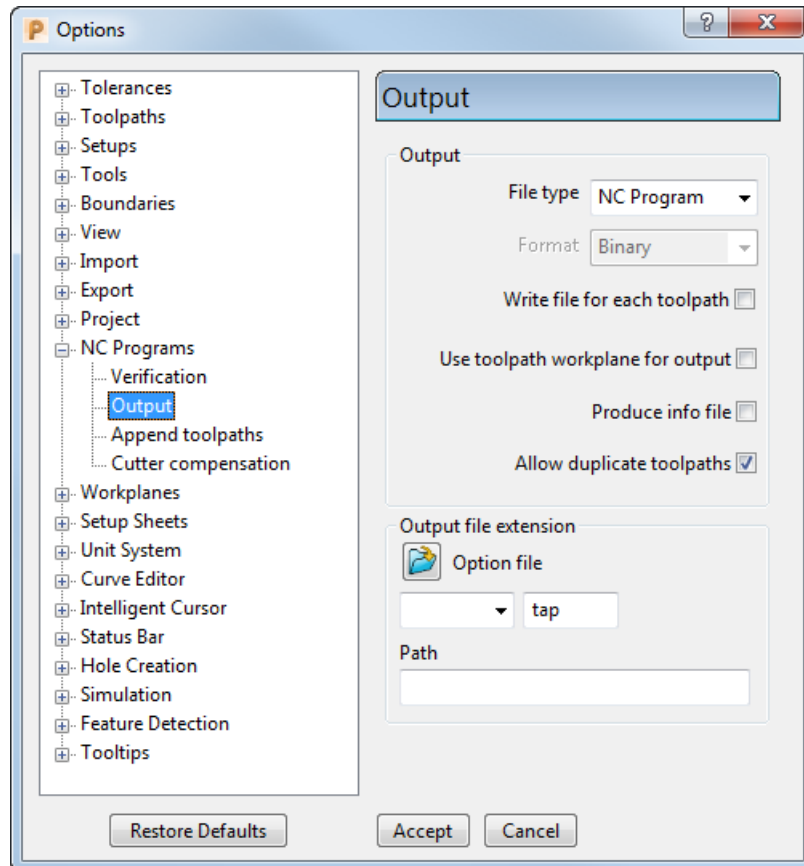
Creating an NC program

- 1 From the **NC Programs** context menu, select **Create NC Program**. This displays the **NC Program** dialog.
- 2 In the **Name** field, enter the name you want to call the NC program. For example **Cavity_Mold**.

The screenshot shows the 'NC Program : Cavity_Mold' dialog box. The 'Name' field is set to 'Cavity_Mold'. The 'Output File' is 'E:\PowerMill_Projects\forging_example\ncprograms\{ncprogram'. The 'Machine Option File' is 'C:\Users\Public\Documents\PostProcessor 2015 (64-bit) Files'. The 'Machine Tool' and 'Model Location' are dropdown menus. The 'Output Workplane' is a dropdown menu. The 'Program Number' is '1'. The 'Part Name' is '1'. The 'Tool Value' is 'Tip'. The 'Automatic Tool Alignment' is 'On'. The 'Connection Moves' is 'Simultaneous'. Below these fields is a tabbed interface with tabs for 'Toolpath', 'Num...', 'Diam...', 'Tip', 'Gauge', 'Overha...', 'Toleran...', 'Thickn...', and 'Axial Thick'. The 'Toolpath' tab is selected. Below the tabs are 'Tool Change' (set to 'On New Tool') and 'Tool Numbering' (set to 'As Specified'). There is a 'Reset' button and 'Tool Change Position' (set to 'After Connecti'). Below this is a 'Toolpath' section with 'Tool' settings: 'Tool Number', 'Gauge Length', and 'ID'. Below that is a 'Cutter Compensation' section with 'Length' (set to 'On'), 'Radius' (set to 'None'), 'Length Offset Number', and 'Radius Offset Number'. Below that is a 'Drilling Cycle Output' (set to 'On') and 'Coolant' (set to 'Standard'). There is a 'Fixture offset' dropdown and an 'Output File' field. At the bottom are 'Write', 'Apply', 'Accept', and 'Close' buttons.

- 3 In the **NC Program** dialog, click the **Options**  button. The **Options** dialog is displayed.
- 4 On the **Output** tab:

- a If selected, deselect the **Write File for Each Toolpath** option. As a result, the **Output File** is displayed at the top of the **NC Program** dialog instead of the **Root Name**.
- b Select **Option File** as **heid400**.
- c Enter **Output File Extension** as **tap**.
- d Click **Accept** to update and close the **Options** dialog.

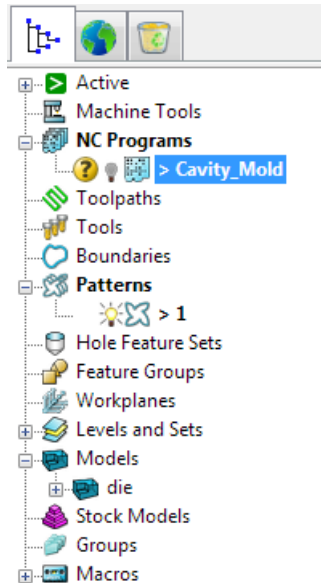


*If you want separate output files for each toolpath, select **Write File for Each Toolpath** option. This changes the **Output File** field to **Root Name** in the **NC Program** dialog and displays the default path and file name in the **Output File** field at the bottom of the dialog.*

The default path in the **Output File** field is based on the settings in the **NC Preferences** dialog. If you want to change this path, click the open folder  button, browse to the appropriate folder, and enter the new file name (the file extension is determined by the settings you made in step 4b). If you used the **%[ncprogram]** variable in the **NC Preferences** dialog, hover over the path to see how the file name is displayed in PowerMill.

- 5 Click **Accept** in the **NC Program** dialog to accept your selections and close the dialog.

- 6 To see the entity that you have just created, click  to expand the **NC Programs** node. The entity is automatically **active** (signified by **bold** text preceded by the > symbol).



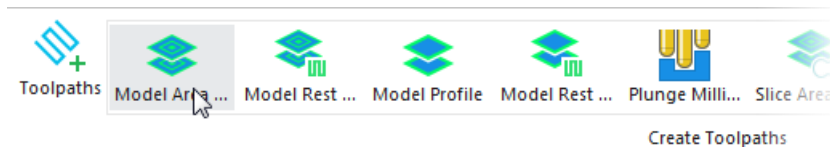
Any toolpaths you create are automatically added to the currently active NC program.

Creating a roughing toolpath

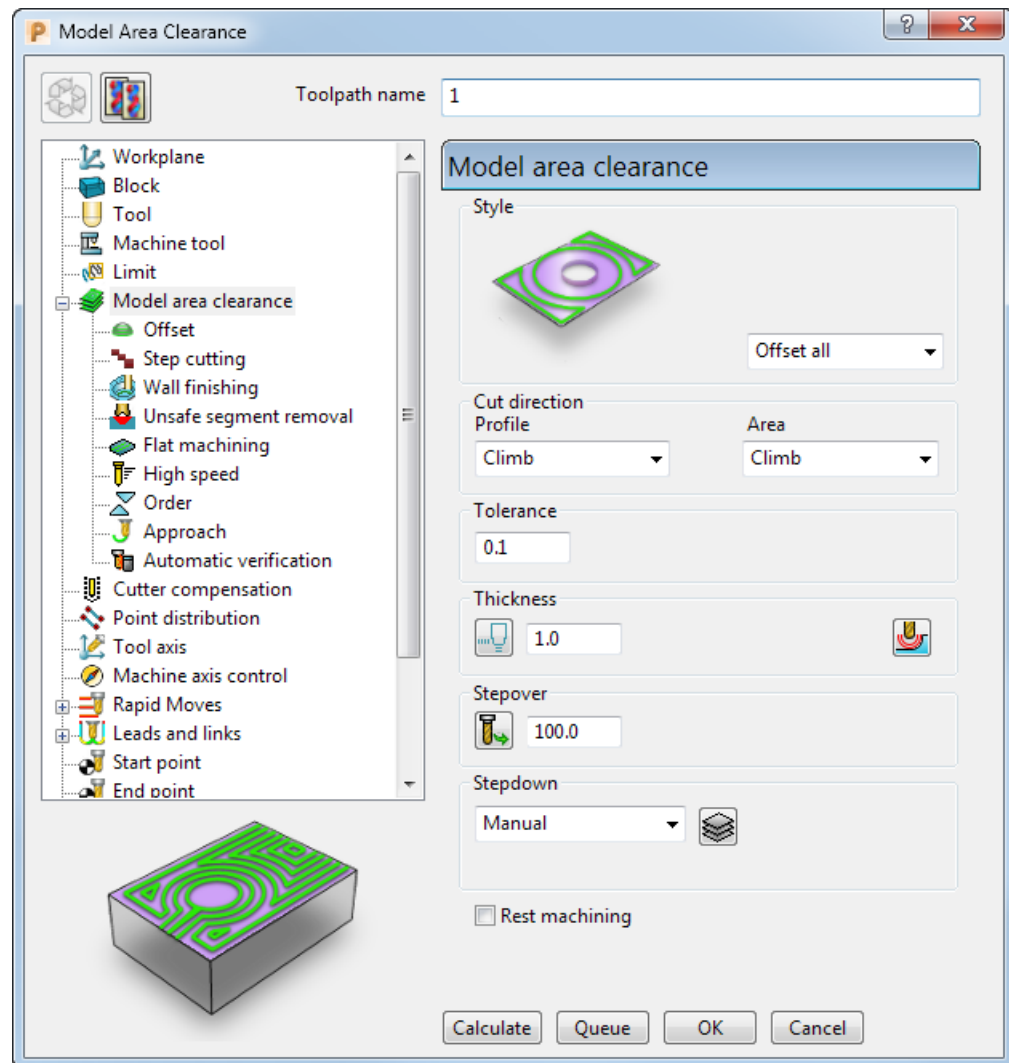
A **Model Area Clearance** strategy with the roughing **Style** set as **Offset all** is used to rapidly remove the majority of excess material on the model. This clears the area with contours that are generated by repeatedly offsetting the initial contour until no further offsetting is possible. It then steps down to the next level and repeats the offsetting until the bottom of the part is reached.

To create a roughing toolpath:

- 1 On the Home tab > Create Toolpaths panel, select **Model Area Clearance** from the favourites gallery.



This displays the **Model Area Clearance** dialog.



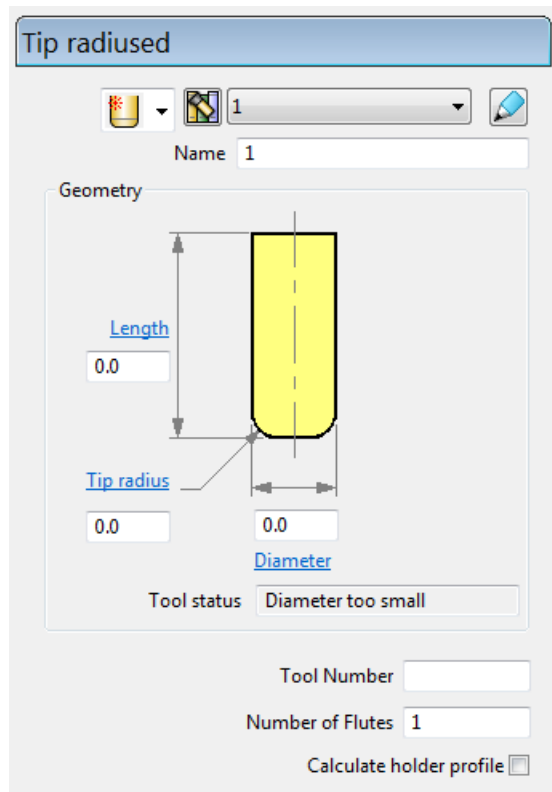
Use the various tabs to enter parameters for the toolpath.

- 2 Give the toolpath an appropriate **Name**, for example **Roughing**.
- 3 Define the roughing tool geometry (see page 28).
- 4 Define the tolerances (see page 34).
- 5 Specify rapid move heights (see page 34).
- 6 Specify tool start points (see page 35).
- 7 Generate the roughing toolpath (see page 36).
- 8 Display the roughing toolpath (see page 37).
- 9 Simulate the roughing toolpath (see page 40).

Defining the roughing tool geometry

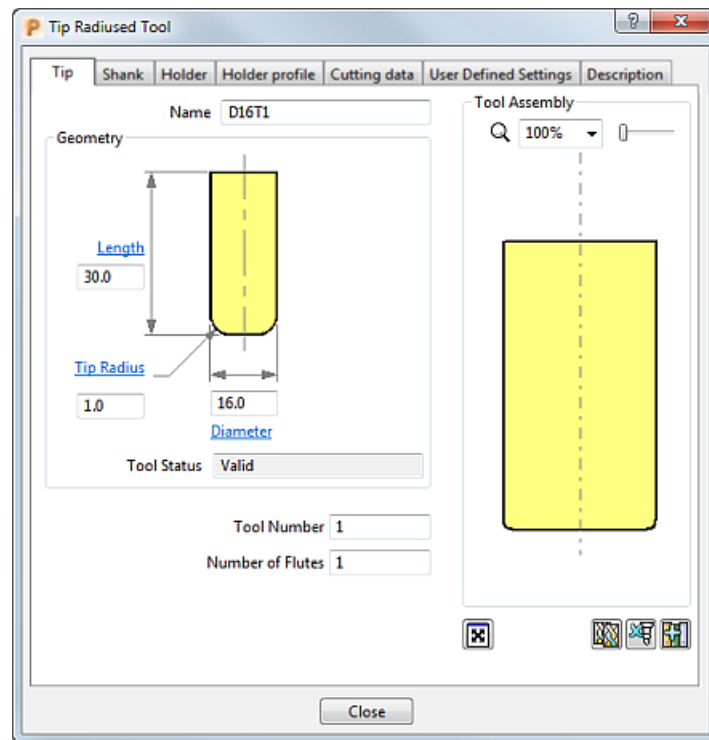
The next stage involves selecting a tool and defining its geometry. This example uses a **16 mm (5/8 inch)** tip-radiused tool.

- 1 In the **Model Area Clearance** strategy dialog, click  **Tool** to display the **Tool** page.
- 2 On the **Tool** page:
 - a Click the  arrow next to the **Create Tool**  button in the **Tool** area.
 - b From the tool list, select  to create a **Tip Radiused Tool**.
- 3 On the **Tool** page, click  to display the **Tip Radiused Tool** dialog.



- 4 In the **Tip Radiused Tool** dialog, enter:
 - a **Name:** **D16T1**
 - b **Length:** **30** mm
 - c **Tip Radius:** **1** mm
 - d **Diameter :** **16** mm

e Tool Number : 1



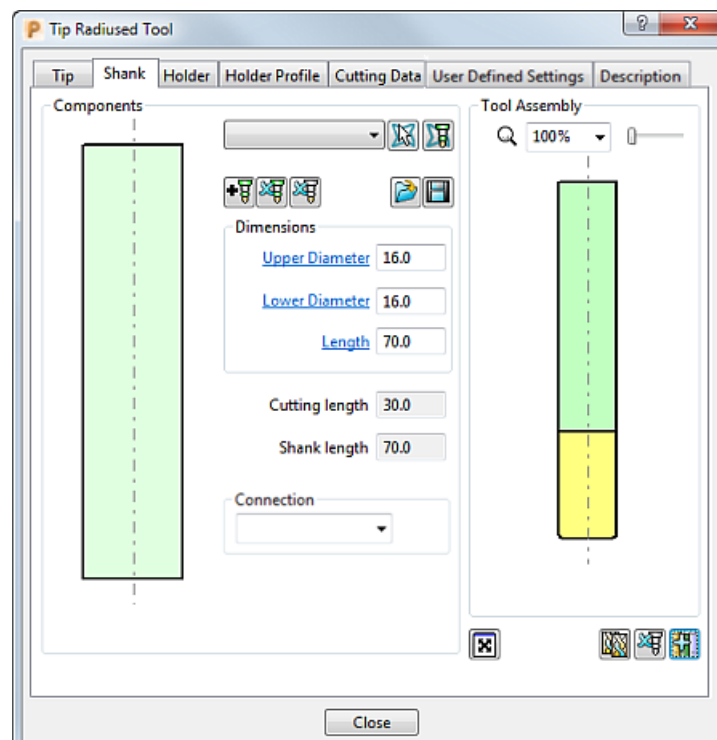
5 Select the **Shank** tab, click  to add a shank component. Enter:

a **Upper Diameter : 16 mm**

b **Length: 70 mm**

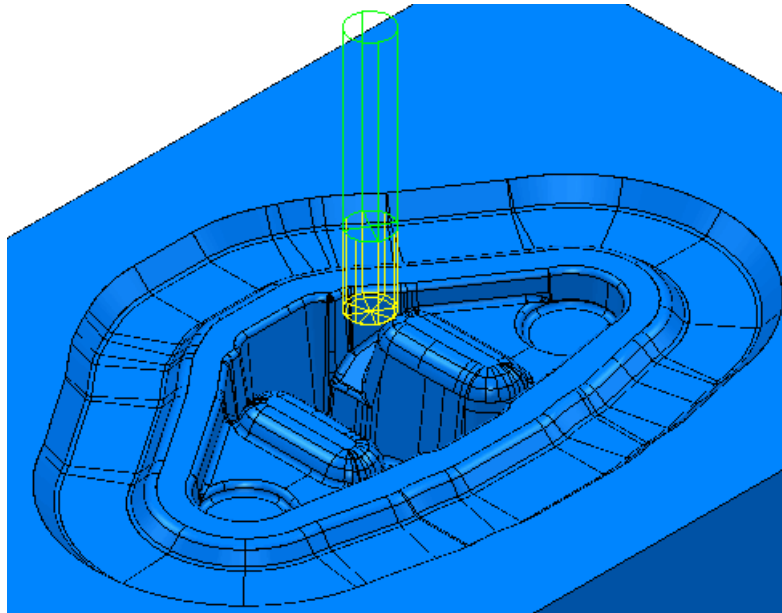


*The **Lower Diameter** automatically defaults to the **Upper Diameter**. This can be accepted for the current tool.*



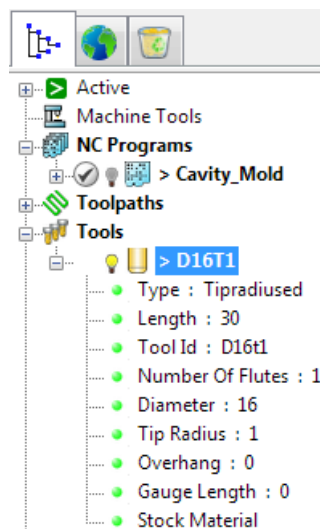
6 Click **Close**.

The tool is automatically aligned with the Z axis:

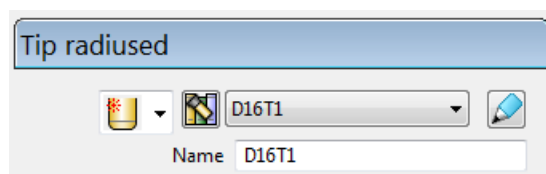


You can view and edit the created tool:

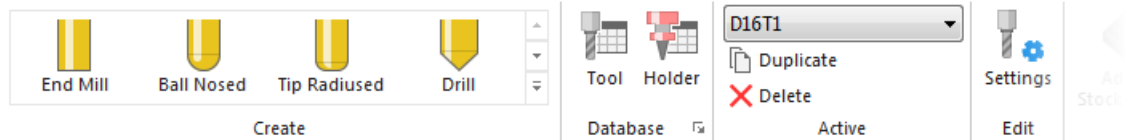
- In the Explorer, expand  **Tools** to see the tool you have created. Expand the tool node to see the tool's specific details.



- In the **Tool** tab on the **Model Area Clearance** dialog:



- On the **Tool** tab:

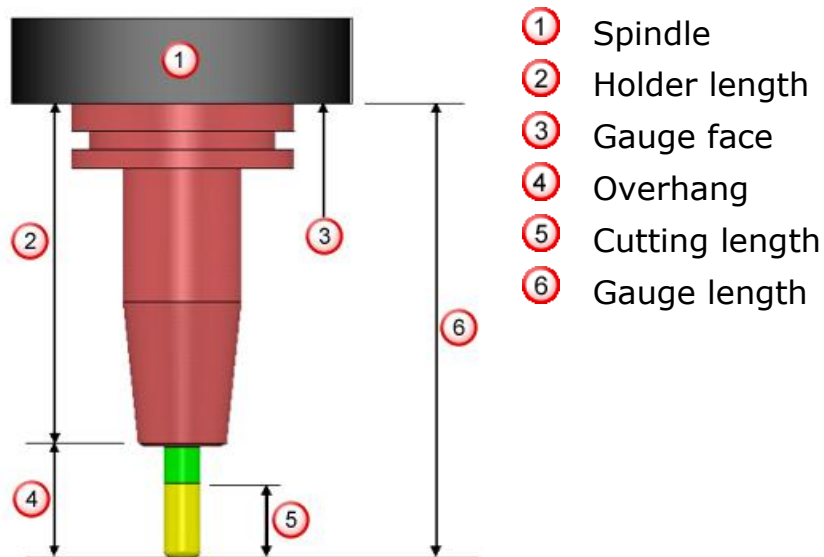


Tool length overview

The diagram shows a cutting tool, made up of a tip (yellow) and shank (green), mounted in a holder (red). The tool is mounted in the spindle of a machine (grey).



*The colours used here correspond to those used in the PowerMill **Tool** dialogs.*



The **Cutting length** represents the part of the cutter that removes material. This is the **Tip length**.

The **Overhang** is the amount by which the cutter protrudes from the tool holder. This typically includes part of the **Shank length**. The **Overhang** is fixed when the cutter is mounted in the holder.



*To obtain maximum tool life, keep the **Overhang** to the minimum length necessary to prevent the holder from hitting the part or unmachined stock.*

The **Holder length** is the total length of all parts of the holder assembly that protrude from the spindle when the holder is mounted in the machine.

The **Gauge length** is the total length of the cutter and holder assembly when it is mounted in the machine. It is measured from the tip of the tool to the Gauge face, which is the ground face of the spindle.

Defining the tolerances

On the **Model area clearance** page of the strategy:

- 1 In **Tolerances**, enter: **0.2** mm.
- 2 Click on the **Thickness**  button to enable the **Radial thickness** and **Axial thickness** fields.
- 3 Enter a **Radial thickness**  of **0.5** mm.
- 4 Enter an **Axial thickness**  of **0.1** mm.
- 5 In **Stepover**, enter: **7.0** mm.
- 6 In **Stepdown**, enter: **4.0** mm.
- 7 In the stepdown list, select **Automatic**.



*The **Z Heights** are created automatically when the toolpath is calculated, and any existing **Z Heights** values are deleted.*



The accuracy of the machined part produced by PowerMill is limited by the accuracy of the model read into the program. The original model must have been produced to an adequate tolerance.

Specifying rapid move heights

The heights at which the tool can move safely without hitting the part or clamps are called rapid move heights.

Use the **Rapid moves** page on a strategy dialog to define the **Safe Z** and **Start Z** tool heights:



*To change rapid move heights after a toolpath is calculated, click **Home tab** > **Setup panel** > **Toolpath connections** to display the **Safe area** tab of the **Toolpath connections** dialog.*

- 1 Select the **Rapid Moves** page  **Rapid Moves** on the **Model Area Clearance** strategy dialog.

- 2 On the **Rapid Moves** page, in the **Type** list, select **Plane**.

The screenshot shows the 'Rapid Moves' dialog box. It has a title bar 'Rapid Moves'. Below it, the 'Safe area' section contains a 'Type' dropdown set to 'Plane' and a 'Workplane' dropdown set to 'Toolpath workplane'. The 'Normal' section has three input fields with values 0.0, 0.0, and 1.0, and a small icon to the right. Below this, 'Rapid height' is set to 40.0 and 'Plunge height' is set to 35.0. There is a 'Use polar links' checkbox which is unchecked. The 'Calculate dimensions' section has a 'Measured from' dropdown set to 'Block and Model', 'Rapid clearance' set to 10.0, and 'Plunge clearance' set to 5.0. A 'Calculate' button is at the bottom of this section. At the very bottom of the dialog are two checkboxes: 'Draw rapid surface' and 'Draw plunge surface', both of which are unchecked.

Specifying tool start point

- 1 Select the **Start point** page  **Start point** on the **Model Area Clearance** strategy dialog.
- 2 On the **Start Point** page, in the **Use** list, select **Block Centre Safe**.

This resets the tool X and Y values to the centre of the block model, with the Z coordinate at **Safe Z**.

Start point

Use **Block centre safe**

☒ Incremental plunge
☐ Direct move
☐ Override tool axis

☒ Separate approach

Approach along **Tool axis**

Approach distance **0.0**

Incremental plunge distance
Distance **5.0**

Measured from **Stock**

Coordinates
0.0 0.0 0.0

Tool axis
0.0 0.0 1.0

Generating the roughing toolpath

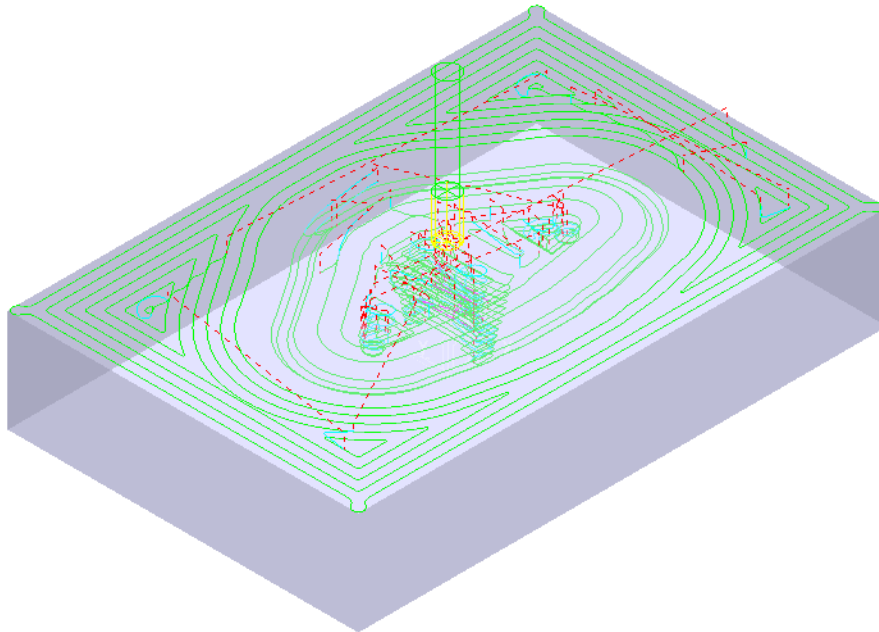
On the **Model Area Clearance** strategy dialog:

- 1 Select and expand the **Leads and links** page:
 - a Select the **Lead in** sub page.
 - b From the **1st choice** list, select **Ramp**.
 - 2 Select the **High speed** page:
 - a Select the **Profile smoothing** option. Leave the default **Corner Radius** as **0.05**.
 - b Select **Raceline smoothing**, and adjust it to a small value, such as **5%**.
 - 3 Click **Calculate** to generate the toolpath.
- Progress is shown on the **Status** bar at the bottom of the screen. The generation may take a minute or so, depending on the processing power of your PC.
- 4 After the toolpath is generated, **Close** the strategy dialog.

Displaying the roughing toolpath

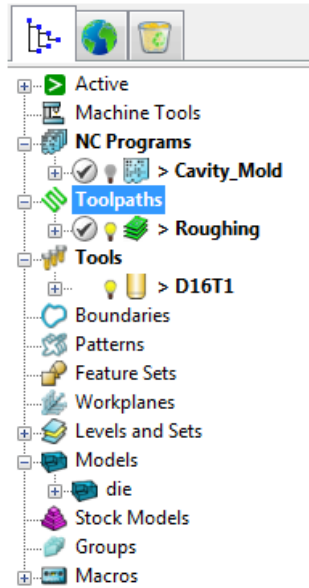
To improve the visual representation of the toolpath, you can:

- Click View tab > Appearance panel > Shade to toggle the shaded representation of the model.
- Click View tab > Appearance panel > Wireframe to toggle the wireframe.
- Click View tab > Appearance panel > Block to toggle the block.



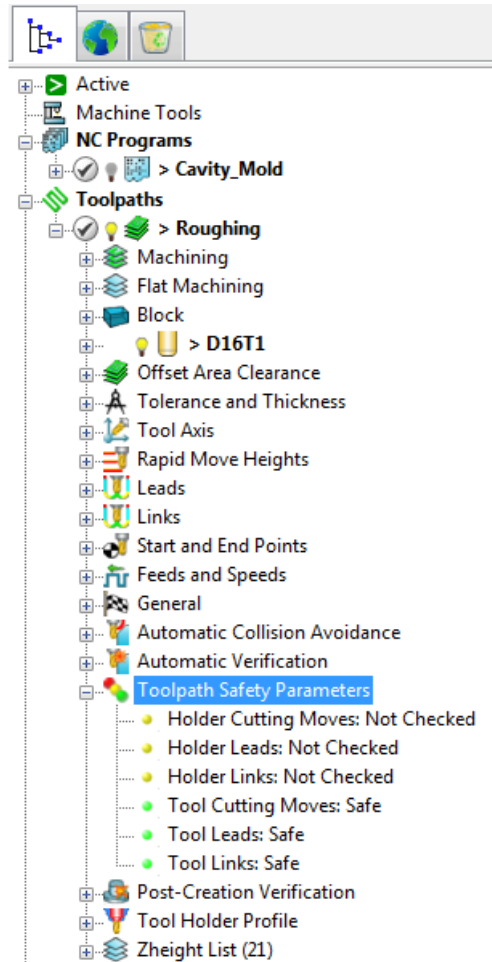
*To zoom in to the model, hold down the **Ctrl** key and the middle (or right) mouse button, and drag the mouse upwards.*

- Click  to expand the **Toolpaths** branch in the Explorer. The new toolpath is shown in **bold** and preceded by the > symbol to indicate it's active.



- Click the light bulb  next to the toolpath to toggle toolpath display on  or off .

- Click  (next to the toolpath) to expand and view the parameters and their specific details used to create the toolpath.



The **Safety Status** icon  at the top of the toolpath tree shows the toolpath is gouge-checked, but not checked for holder details. To see more information, expand the **Toolpath Safety Parameters** node in the toolpath tree.

Saving project changes

When you have unsaved changes (in this case, the toolpath information) in your project, an asterisk (*) is displayed in the title bar.

[Editable Project *forging_die_mold]

Click File tab > Save to save the project changes and overwrite the previous file. The toolpath information is added to your project, and the asterisk disappears from the project header:

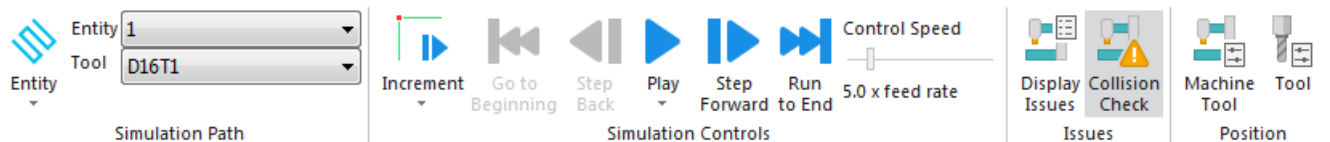
[Editable Project - forging_die_mold]

Simulating the roughing toolpath

To view a simulation of the toolpath:

- 1 Click View tab > Views panel > ISO > ISO 1 to reset the view.
- 2 Click Simulation tab > ViewMill panel > Off. It turns green and changes to **On**.
- 3 Click Simulation tab > Simulation path panel > Entity and select the toolpath you want to simulate.

The associated tool is selected automatically, and the Simulation Controls are highlighted:

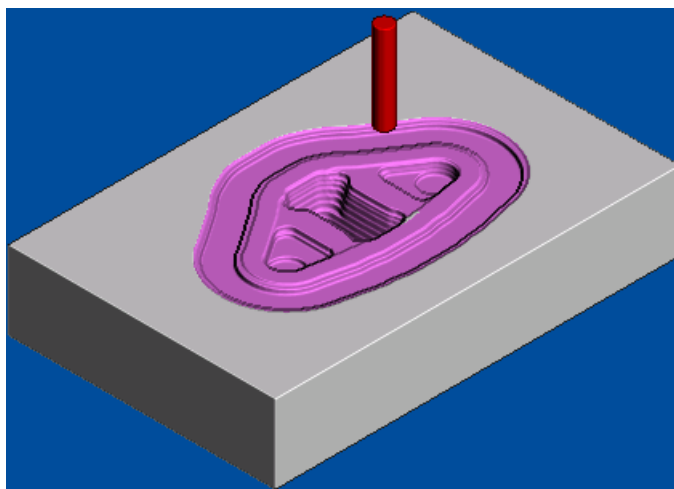


- 4 For the best visual representation of material being removed by different toolpaths, for example roughing and rest roughing, click:
 - Simulation tab > ViewMill panel > Mode > Fixed direction.
 - Simulation tab > ViewMill panel > Shading > Rainbow.



The buttons on the Simulation tab > ViewMill panel > Mode menu and Simulation tab > ViewMillpanel > Shading menu control the display of the simulation.

- 5 To start the simulation, click Simulation tab > Simulation Controls panel > Play. Allow the simulation to run through to the end.

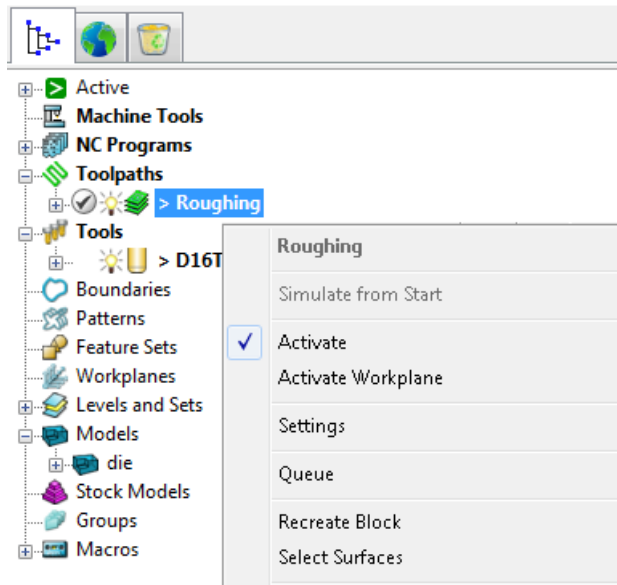


Creating the rest roughing toolpath

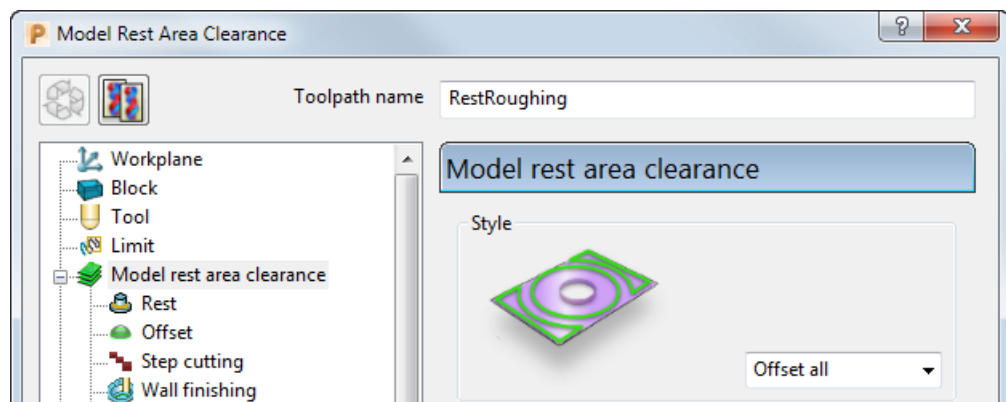
The rest roughing toolpath uses a smaller tool to eliminate the large terraces and to rough areas of the model that the large roughing tool could not reach, such as pockets and corners.

To create a rest roughing toolpath:

- 1 Display the **Settings** for the previous toolpath.



- 2 Click the **Create a new toolpath based on this one** button  button.
- 3 A copy of the toolpath is created with the suffix '_1'. Enter **RestRoughing** in the **Toolpath name** field to rename it.
- 4 Select the **Rest Machining** option. This switches the strategy to **Model rest area clearance strategy** and enables the **Rest** page.



- 5 Define the rest roughing tool geometry (see page 42).
- 6 Change the **Stepover** and **Stepdown** values (see page 43).
- 7 Complete the **Model rest area clearance** strategy dialog, and generate the rest roughing toolpath (see page 44).

- 8 Display the rest roughing toolpath (see page 44).
- 9 Simulate the rest roughing toolpath (see page 46).

Defining the rest roughing tool geometry

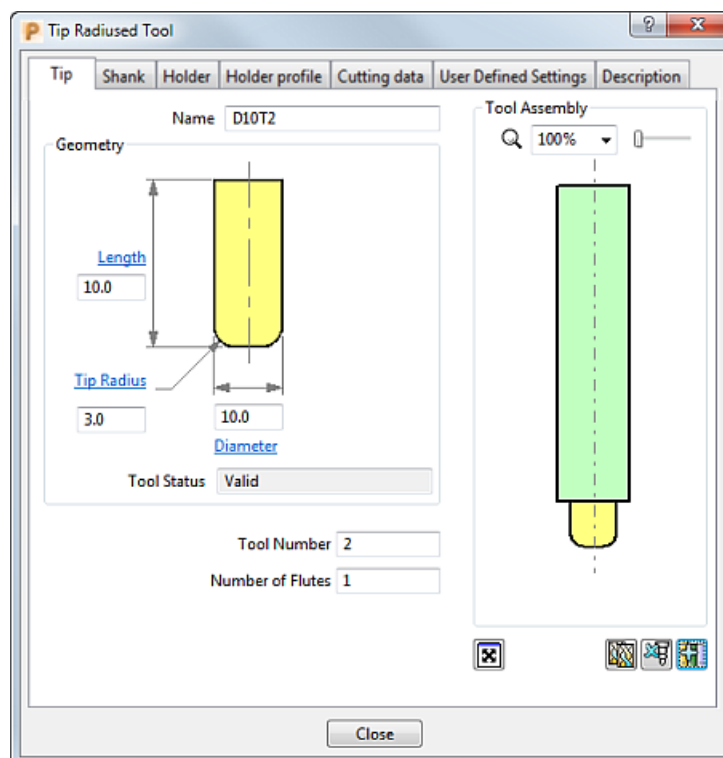
You can base the rest roughing tool on the existing roughing tool, although it needs a smaller diameter and larger tip radius.

This example uses a **10 mm (3/8 inch)** tip radiused tool.

- 1 On the **Tool** page of the **Model Rest Area Clearance** dialog (of the **RestRoughing** toolpath), click the **Edit**  button.



- 2 In the **Tip Radiused Tool** dialog, click  to create a new tool entity based on the existing roughing tool. It is given the default name of **D16T1_1**.
- 3 Rename the tool to **D10T2**.
- 4 In the other fields, enter:
 - a **Length: 10 mm**
 - b **Tip Radius: 3 mm**
 - c **Diameter: 10 mm**
 - d **Tool Number: 2**

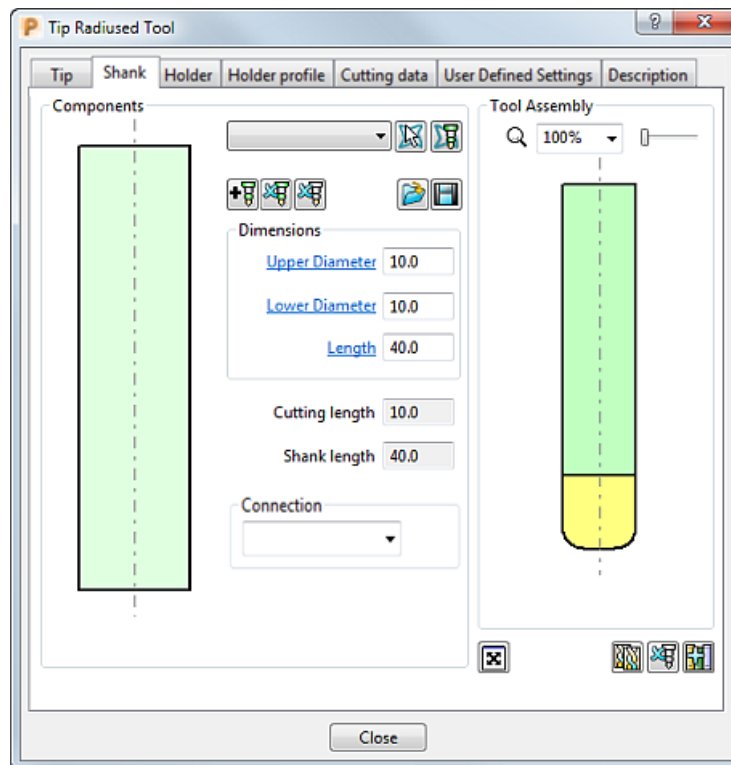


- 5 Select the **Shank** tab and change the values to:

a Upper Diameter: 10

b Length: 40

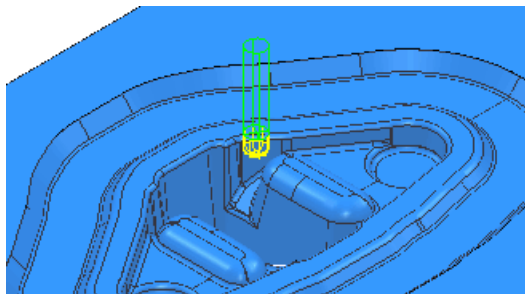
The Lower Diameter automatically defaults to the Upper Diameter. This can be accepted for the current tool.



6 Click **Close**.



To see the rest roughing tool more clearly, click the light bulb icons for the roughing toolpath and tool, (toggle them to). This undraws (but does not delete) the entities from the project.



Changing the Stepover and Stepdown values

On the **Model rest area clearance** page:

- 1 Enter a **Stepover** of 3.0 mm.
- 2 Enter a **Stepdown** of 1.5 mm.

Generating the rest roughing toolpath

On the **Model Rest Area Clearance** dialog:

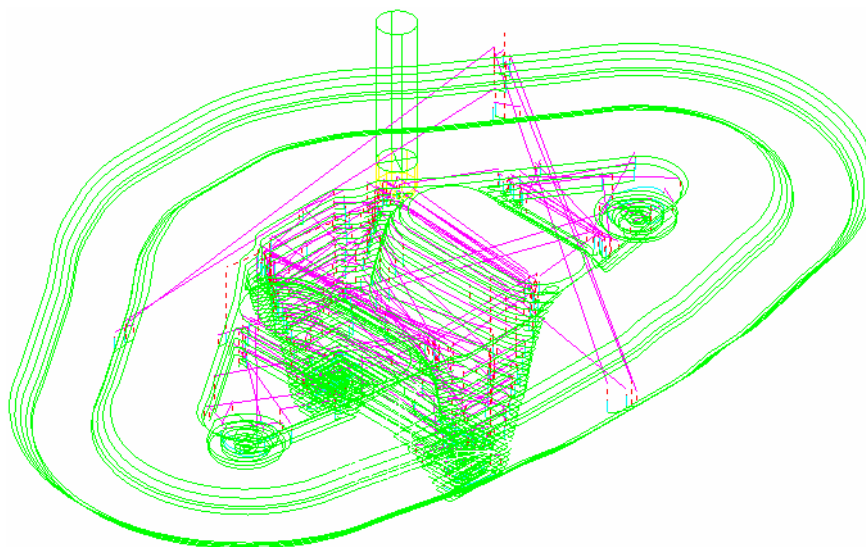
- 1 Select the **Rest** page, and:
 - a From **Rest Machining** type list, select **Toolpath**.
 - b From the **Toolpath** list, select **Roughing** (the name of your roughing toolpath).
 - c In the **Detect Material Thicker Than** field, enter **0.2** mm. The calculation ignores rest material thinner than 0.2 mm. This helps to avoid thin regions being rest roughed where the benefit of a second cut is negligible.
 - d In the **Expand Area By** field, enter: **0.2** mm. The rest areas are expanded by 0.2 mm (measured along the surface). This can be used in conjunction with **Detect Material Thicker Than** to reduce the areas to be machined to the essentials (such as, corners), and then to offset these areas slightly to ensure that all details (for example, on the corners) are machined.
- 2 Click **Calculate** to generate the toolpath.

Progress is shown on the **Status** bar at the bottom of the screen. The generation may take a minute or so, depending on the processing power of your PC.

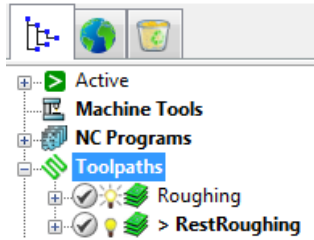
- 3 After the toolpath is generated, **Close** the strategy dialog.

Displaying the rest roughing toolpath

Use the View tab to undraw the model and the block, and then zoom in to view the toolpath:



Click  to expand the **Toolpaths** branch in the Explorer. The new toolpath is shown in **bold** and preceded by the > symbol to indicate it's active.



*The **Safety Status** icon  at the top of the toolpath tree shows the toolpath is gouge-checked, but not checked for holder details. To see more information, expand the **Toolpath Safety Parameters** node in the toolpath tree.*

To save project changes, click File tab > Save.

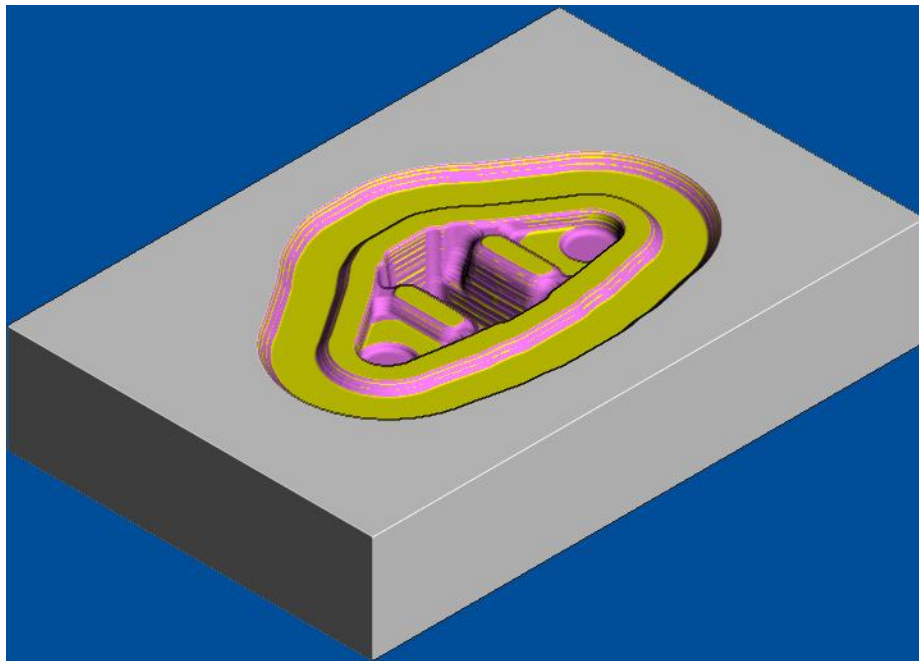
Simulating the rest roughing toolpath

To view a simulation of the rest roughing toolpath:

- 1 Click Simulation tab > Simulation path panel > Entity and select the toolpath you want to simulate.

The associated tool is selected automatically, and the Simulation Controls are highlighted.

- 2 To start the simulation, click Simulation tab > Simulation Controls panel > Play. Allow the simulation to run through to the end.



If you have not started another session since creating the roughing toolpath, the rest roughing toolpath is shown in a different colour, overlaid on the roughing simulation (see page 40).

- 3 Click Simulation tab > ViewMill panel > Exit ViewMill, and select **Yes** to stop the simulation. The **On** button changes to **Off** and the standard PowerMill graphics window is displayed.

Closing the roughing session

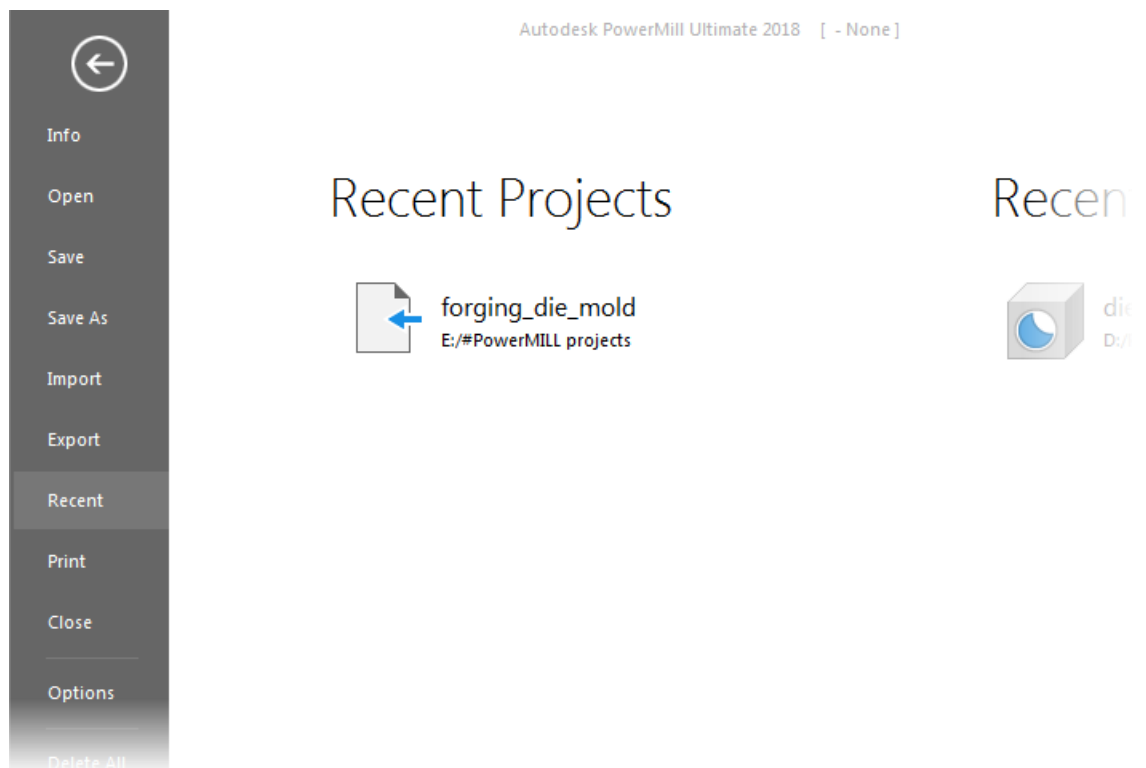
Now you have generated the roughing toolpath. Save the project and close PowerMill until you are ready to create the finishing strategies.

To save project changes, click File tab > Save.

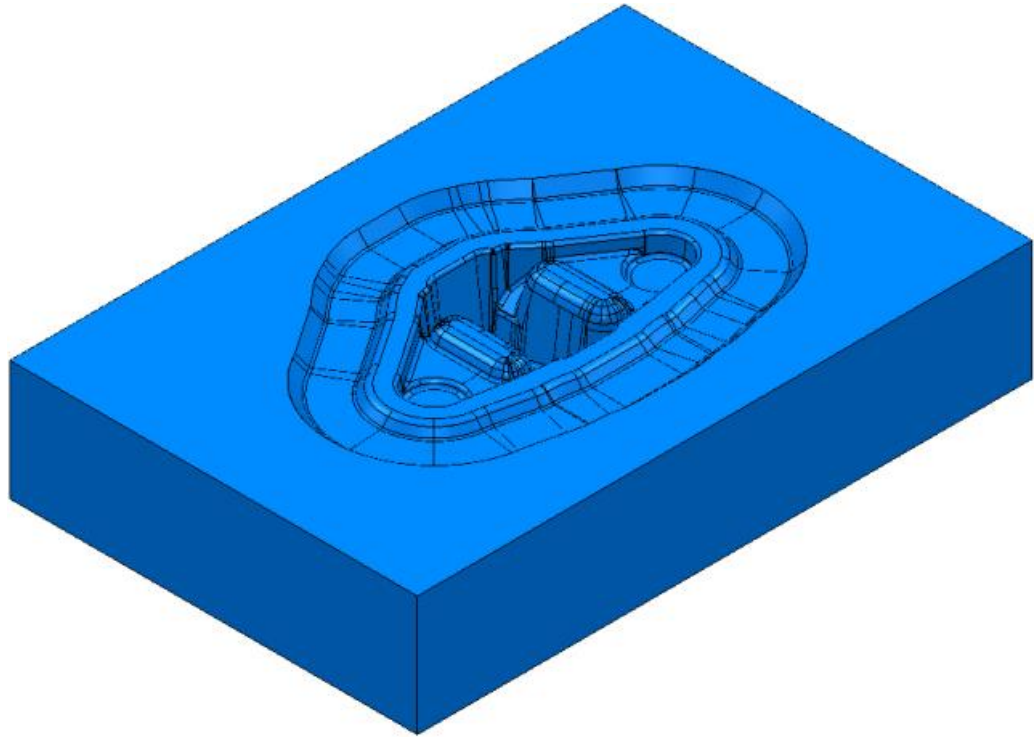
To exit PowerMill, either click File tab > Exit, or click the **Close** button in the top right-hand corner of the PowerMill window.

Re-opening the project

- 1 Restart PowerMill; this automatically loads your toolbar and colour selections from the previous session.
- 2 Click File tab > Recent, and then select the project containing the forging die example:



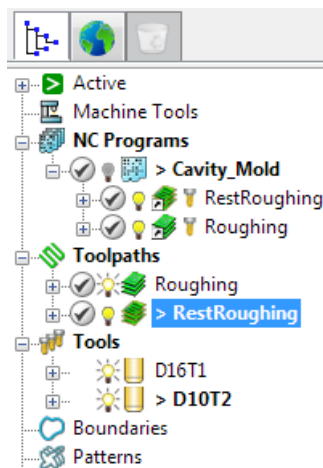
- 3 When the project is reloaded, adjust the model size and orientation as required.



Checking which entities are active

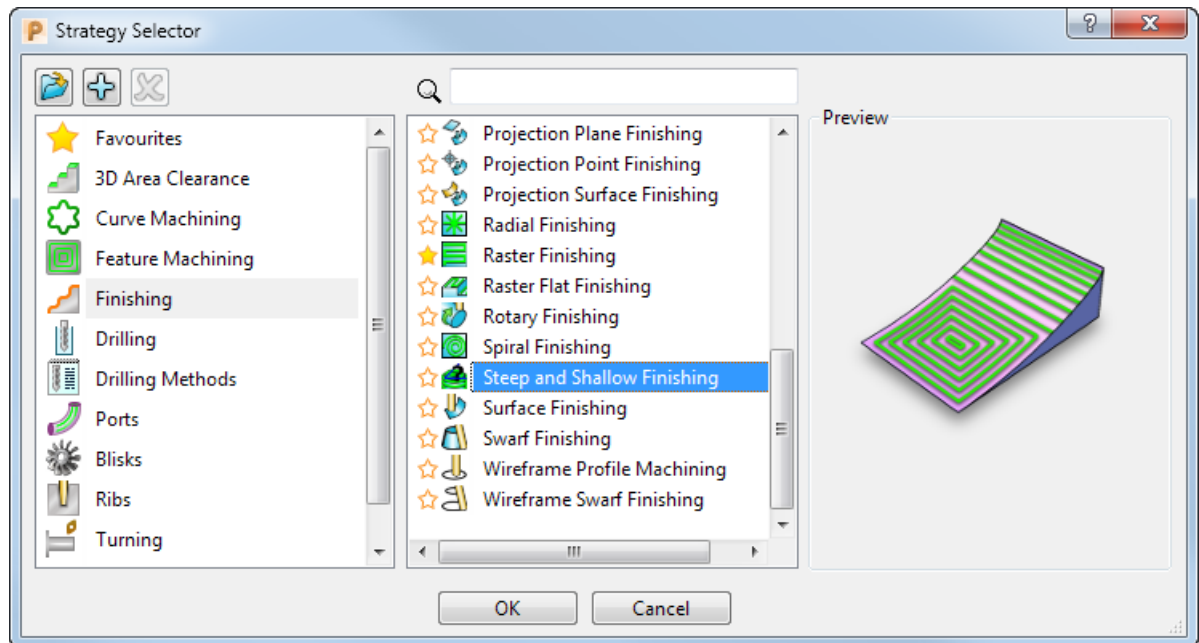
Before you create the finishing toolpaths, you can ensure they are automatically added to an NC program:

- 1 Check if the NC program in the Explorer is shown in **bold** and preceded by the > symbol to indicate it's active. If it's not active, right-click the NC program name, and select the **Activate** option.
- 2 Expand the **Toolpaths** node and click the light bulb icon (until it shows ). This undraws each of the roughing toolpaths. Now you can easily see the new finishing toolpaths as you create them.



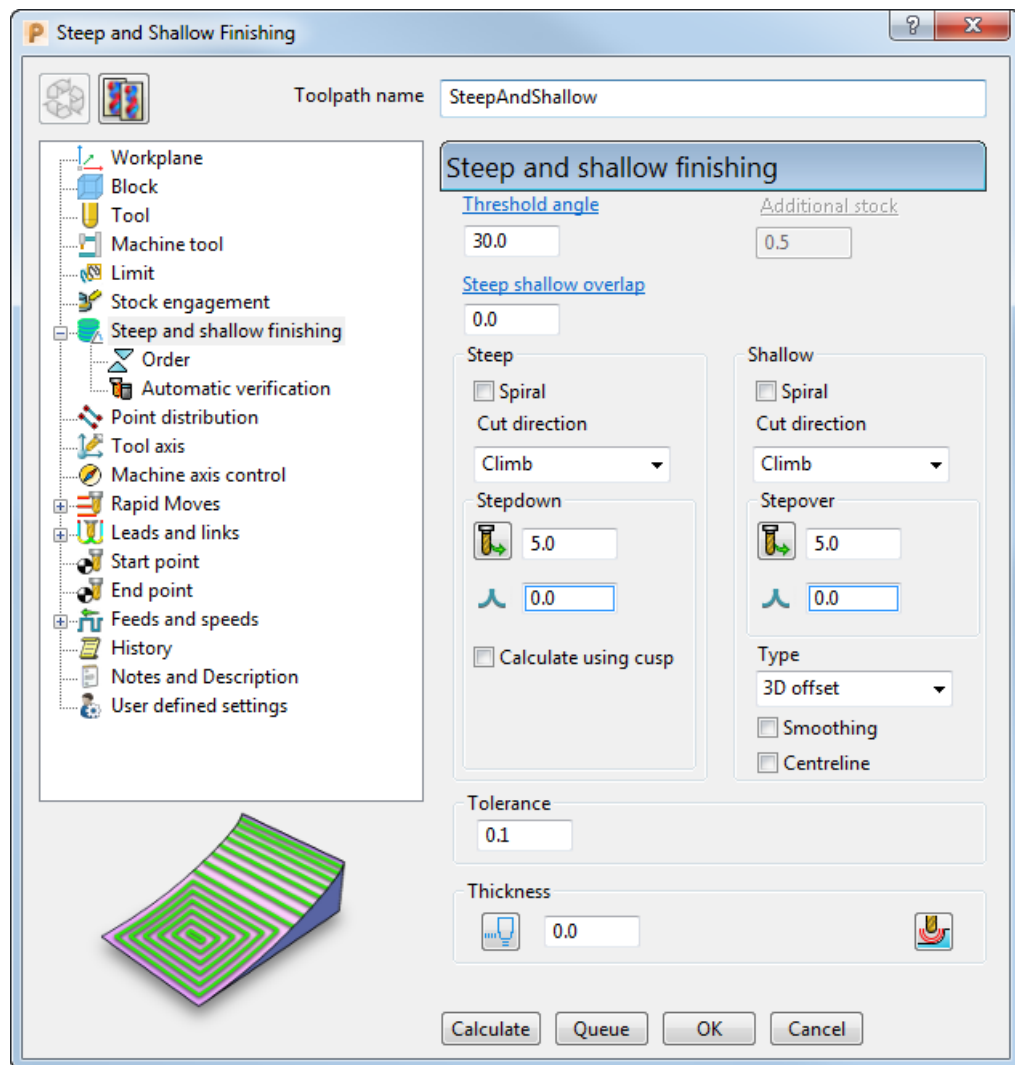
Creating a finishing toolpath

- 1 Click Home tab > Create Toolpaths panel > Toolpaths to display the **Strategy Selector** dialog..
- 2 On the **Finishing** category, select the **Steep and Shallow Finishing** strategy and click **OK**.



- 3 In the **Steep and Shallow Finishing** dialog:
 - a In the **Toolpath Name** field, enter **SteepAndShallow**.
 - b Select **Climb** from the **Cut direction** field.

- c Change the **Stepover** value to **0.5**.

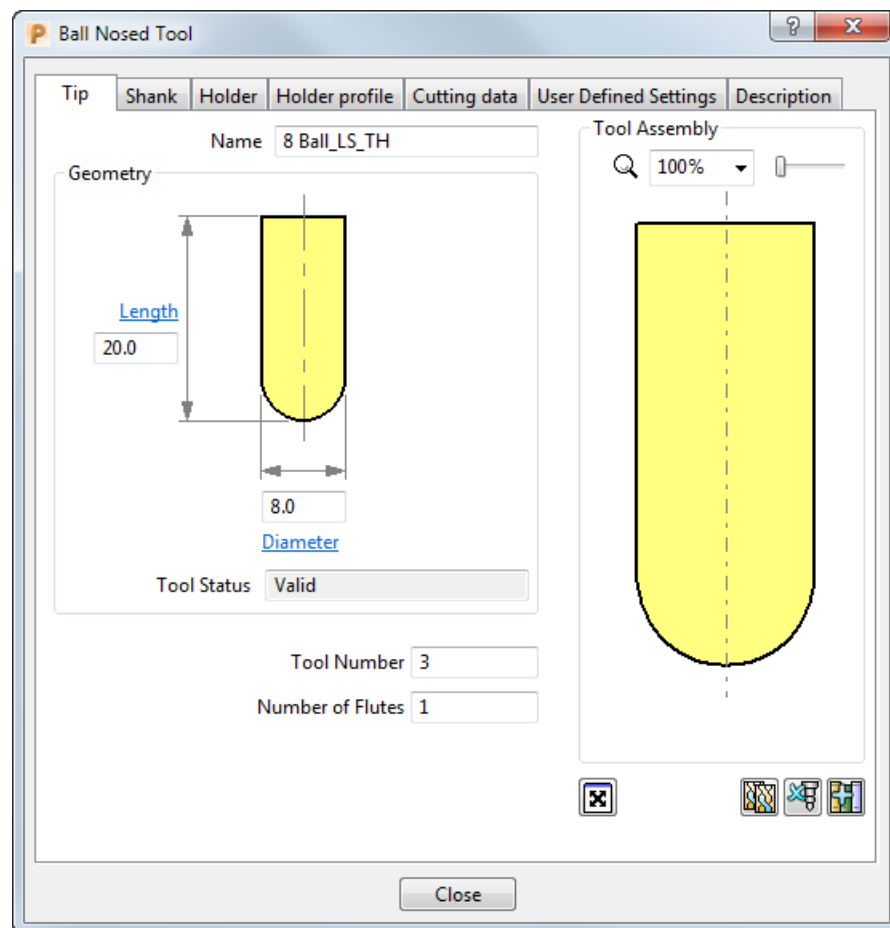


Defining the finishing tool geometry

The tool currently selected for the **Steep and Shallow Finishing** strategy dialog is the same tool that was used for the rest roughing toolpath. This tool is not appropriate for the current toolpath strategy, and must be changed. This example uses an 8 mm (5/16 inch) ball nosed tool.

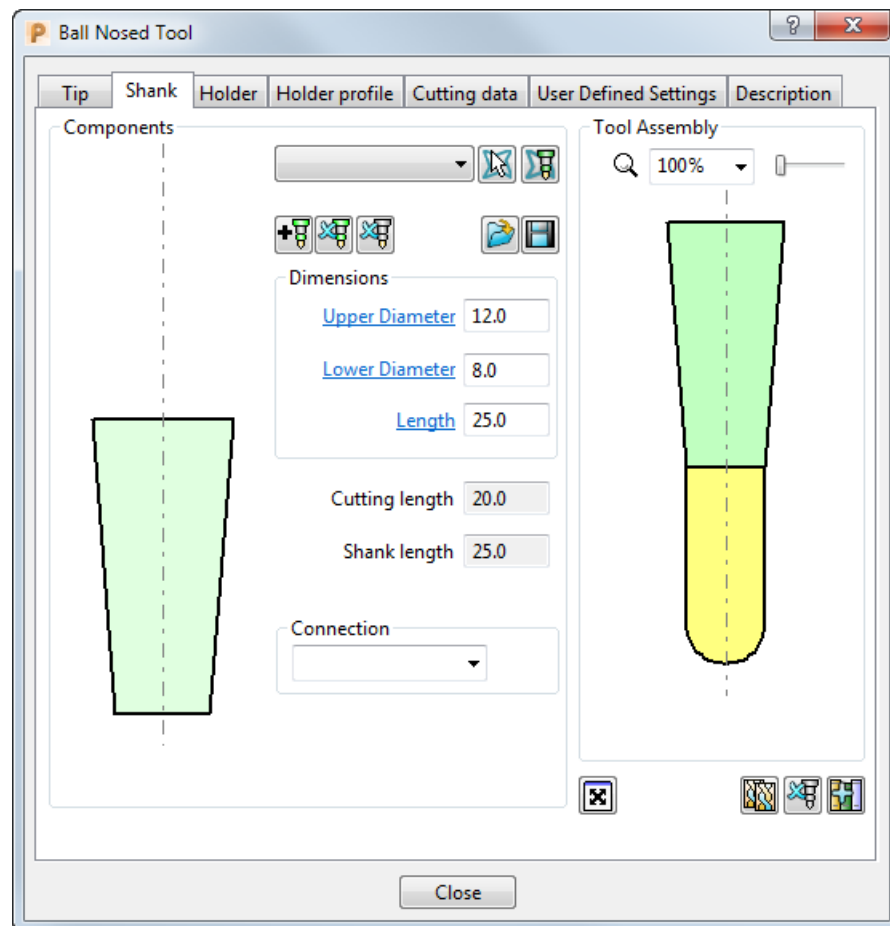
- 1 In the **Steep and Shallow Finishing** strategy dialog, click  **Tool** to select the **Tool** page.
- 2 On the **Tool** page, from the tool list, select  to create a **Ball Nosed Tool**.
- 3 On the **Tool** page, click  to display the **Ball Nosed Tool** dialog.
- 4 In the **Ball Nosed Tool** dialog, enter:
 - a **Name:** 8 Ball_LS_TH

- b Length: 20 mm**
- c Diameter: 8 mm**
- d Tool Number: 3**



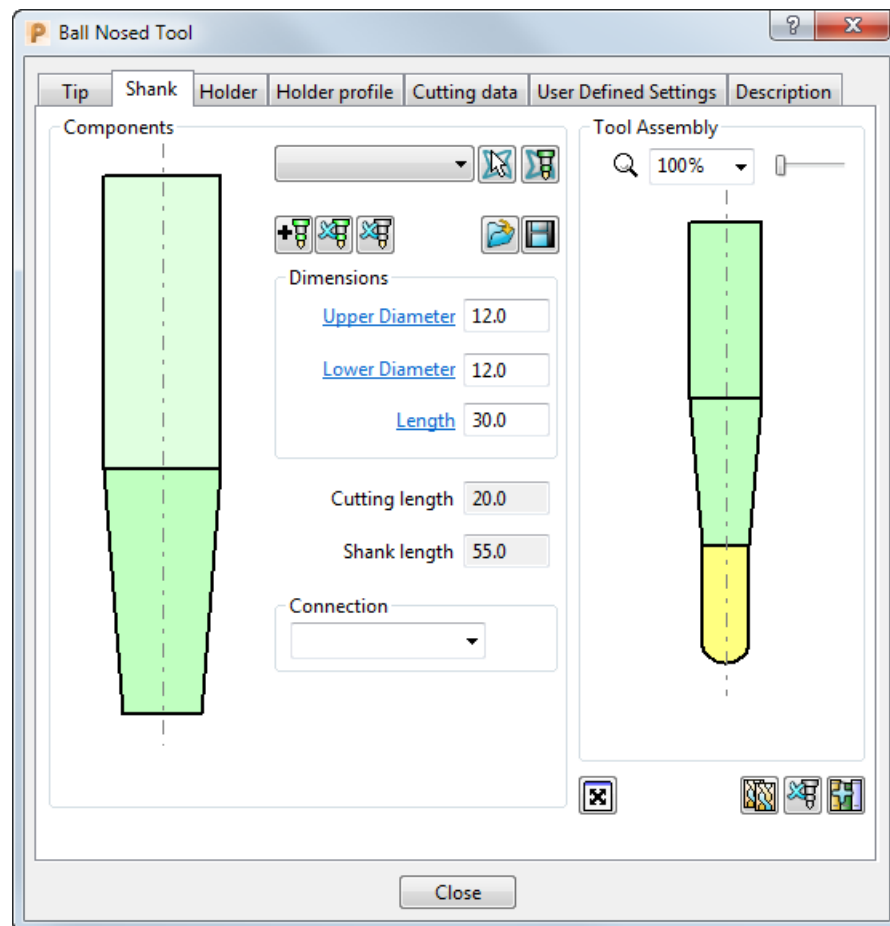
- 5** Select the **Shank** tab, click  to add a shank component. Enter:
- a Upper Diameter: 12**
 - b Lower Diameter: 8**

c Length: 25



- 6 Click the  button to add a second shank component. Enter:
- a Upper Diameter: 12
 - b Lower Diameter: 12

c Length: 30



7 Select the **Holder** tab, and click the  button to add a holder component. Enter:

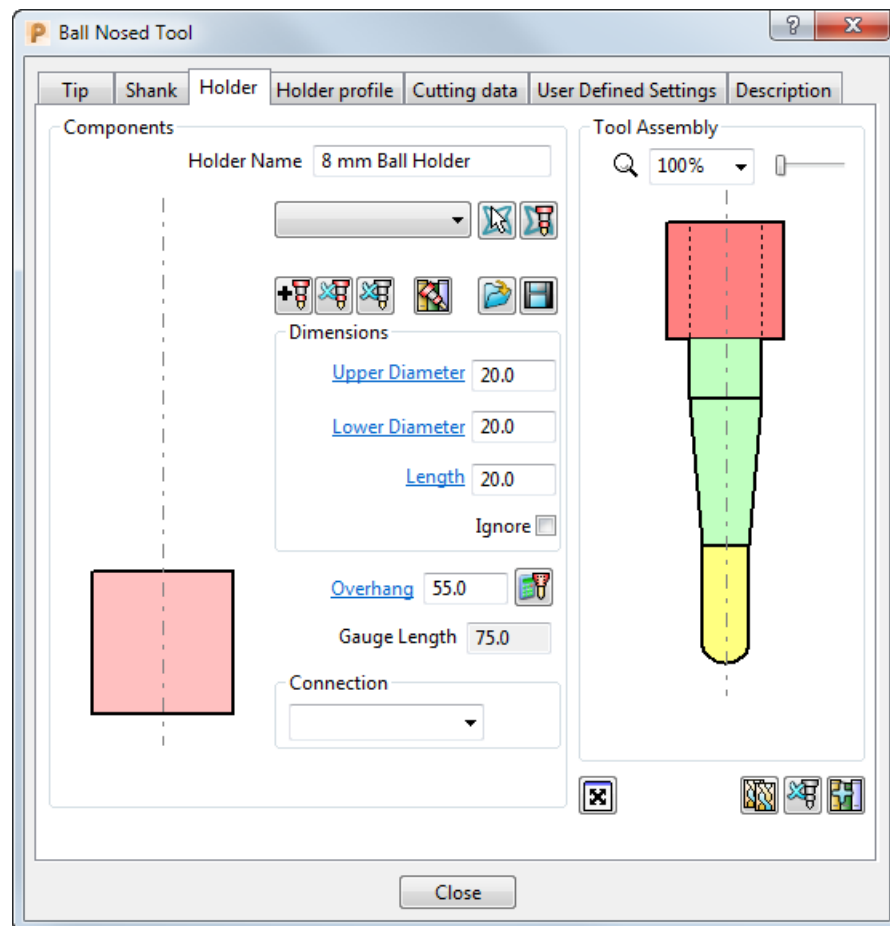
a Name: 8 mm Ball Holder

b Upper Diameter: 20

c Lower Diameter: 20

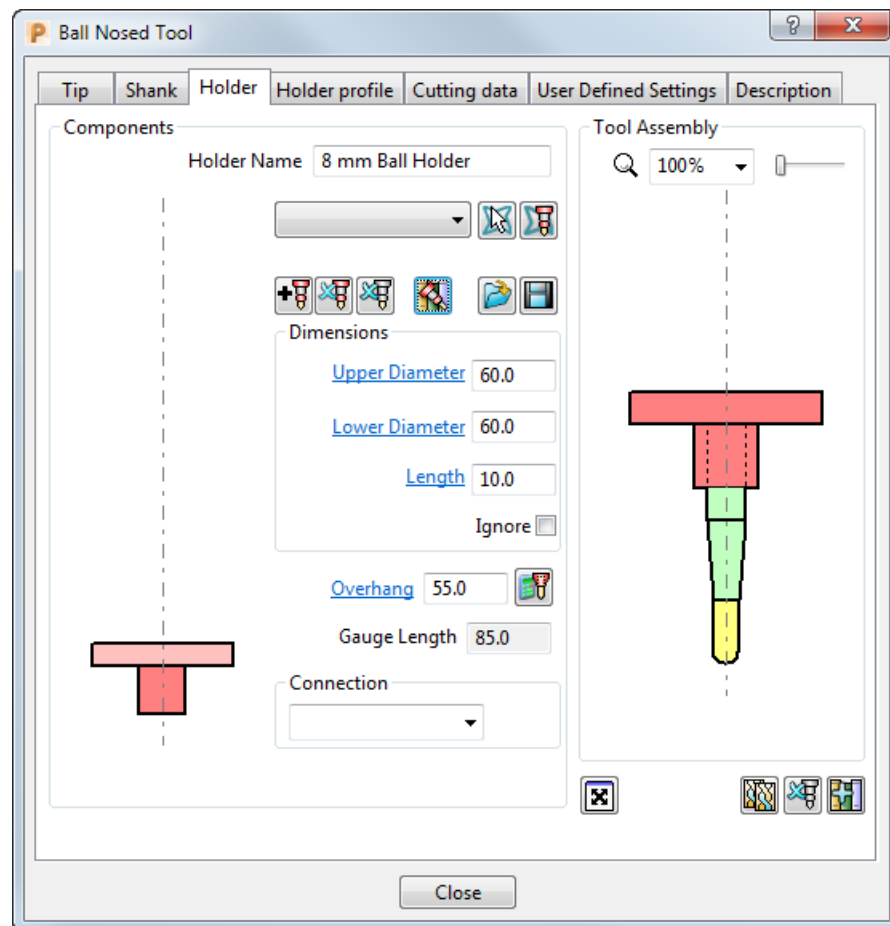
d Length: 20

e Overhang: 55



- 8 Click the  button to add the upper part of the holder. Enter:
- a Upper Diameter: 60
 - b Lower Diameter: 60
 - c Length: 10

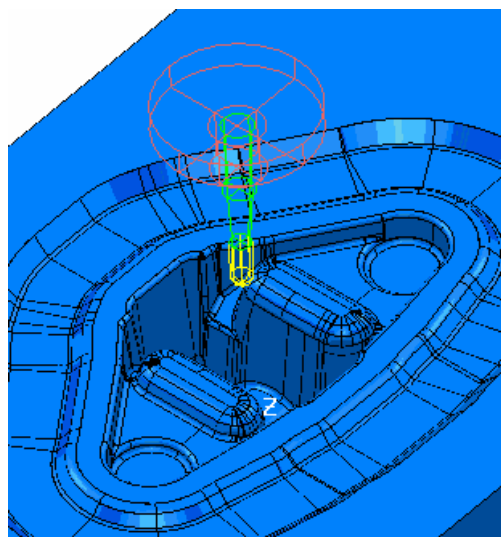
d Overhang: 55



- 9 Click **Close** to update the **Tool** page with the new tool.



*The new tool is shown in the Explorer, and on the **Tool** toolbar, and it's also drawn in the graphics window, where it is automatically aligned with the Z axis.*



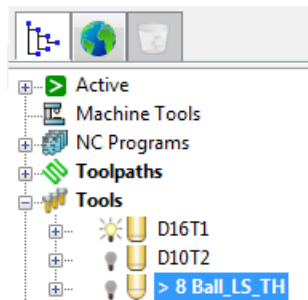
The toolpath is not yet complete because it must reference a boundary, but you can close the dialog without generating the toolpath.

- 10 Click **OK** to close the toolpath dialog.

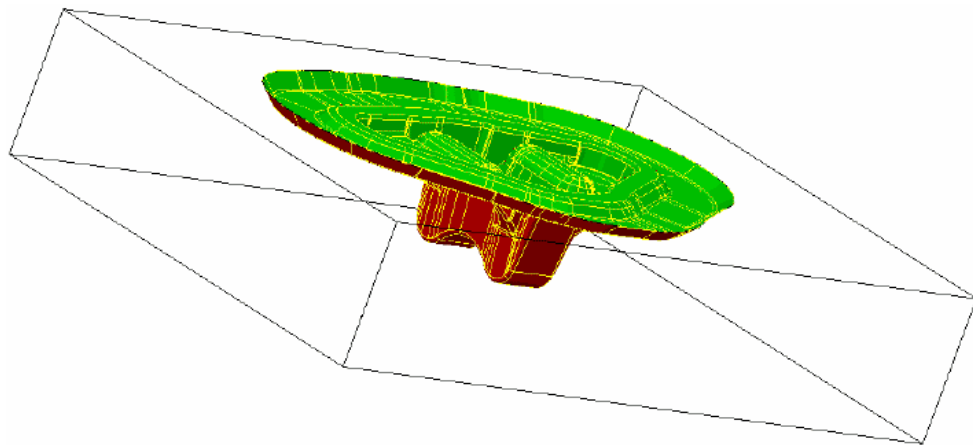
Creating the boundary for the selected surface

Because it is only the cavity that must be finished by this toolpath, you can create a boundary for the cavity.

- 1 Undraw the **8 Ball_LS_TH** tool by toggling the light bulb icon to  in the Explorer.

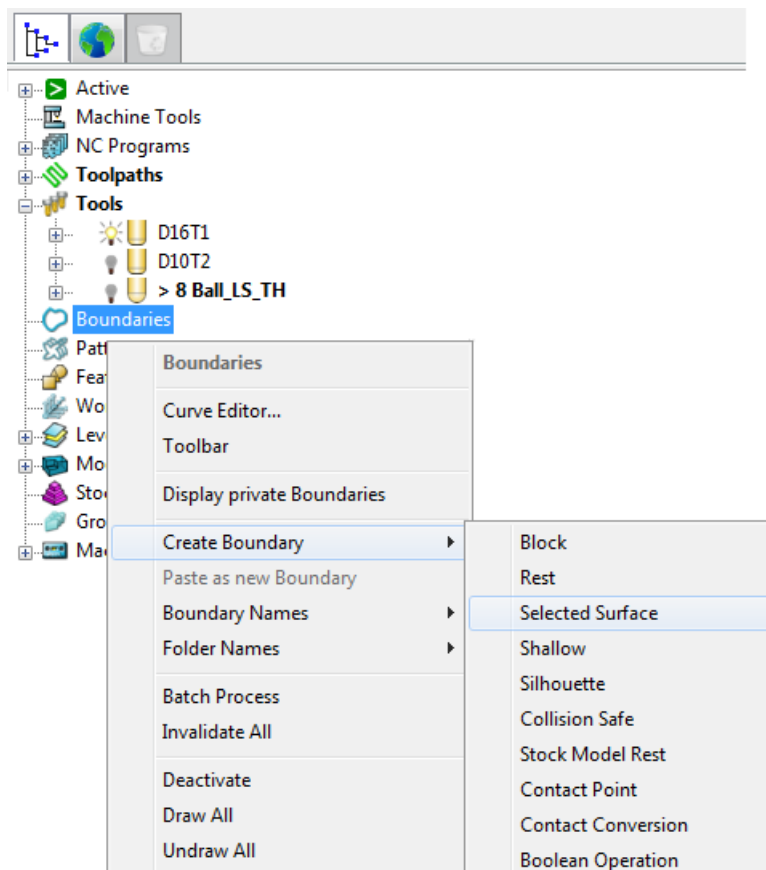


- 2 Click View tab > Appearance panel > Block to undraw the block, and click View tab > Appearance panel > Wireframe to undraw the wireframe.
- 3 Use the mouse to select only the cavity surfaces.



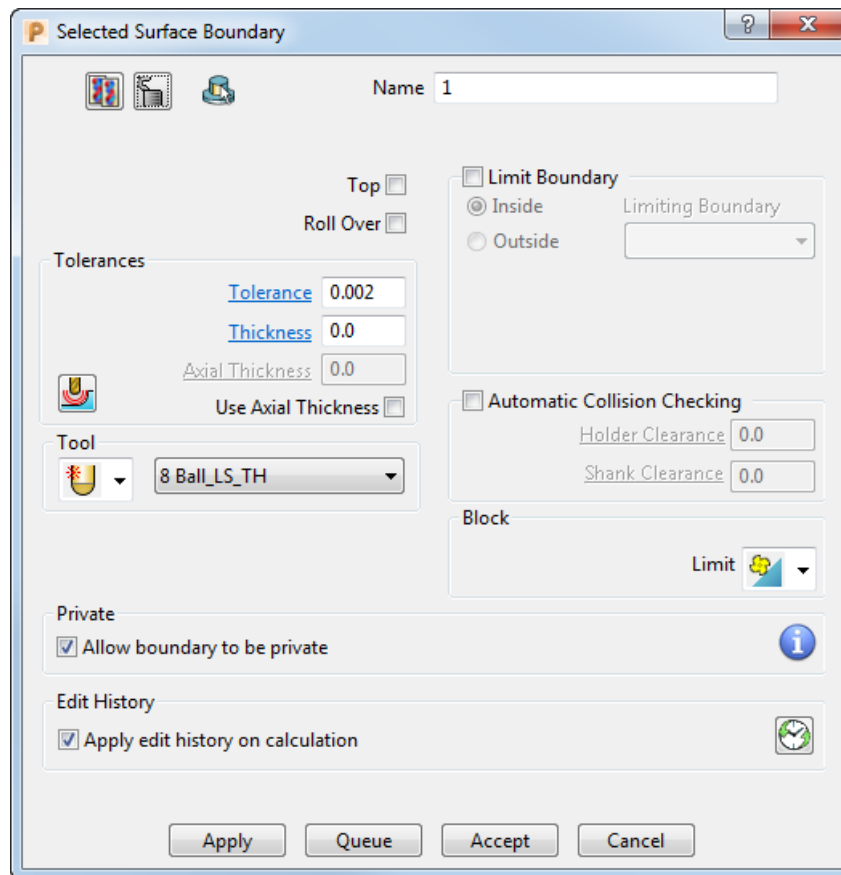
You can use the Home tab > Selection panel > Mode > Drag Select to select multiple surfaces.

- 4 In the **Boundaries** context menu, select **Create Boundary > Selected Surface**.



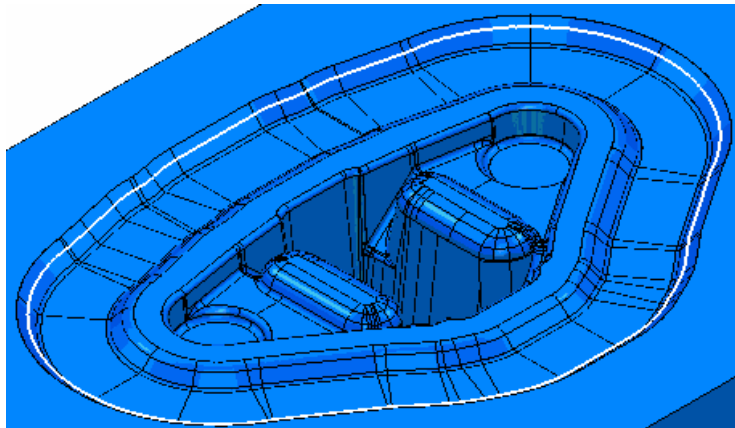
- 5 In the **Selected Surface Boundary** dialog:
- a In the **Name** field, enter **Cavity**.

b In the Tool list, select **8 Ball_LS_TH**.



6 Click **Apply**.

7 The boundary is calculated. By default, it's displayed in white.



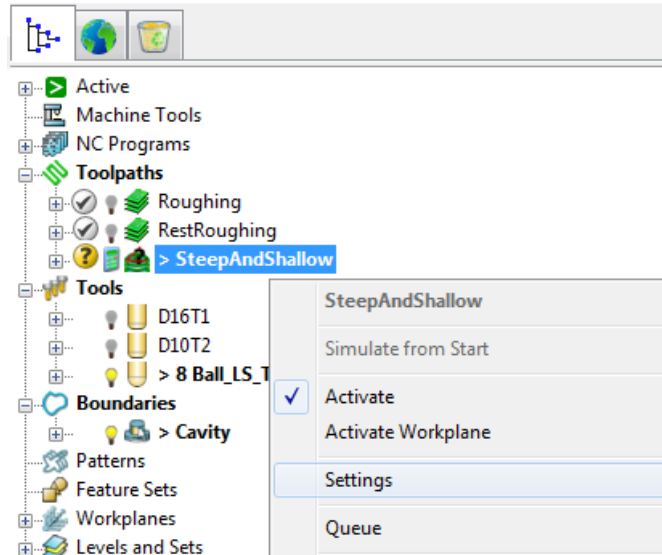
Selected Surface Boundaries are recalculated if the selected surfaces change. This means that they behave like toolpaths in the way they take account of the selection state at the time of calculation.

8 Click **Accept** to close the boundary dialog.

Completing and generating the finishing toolpath

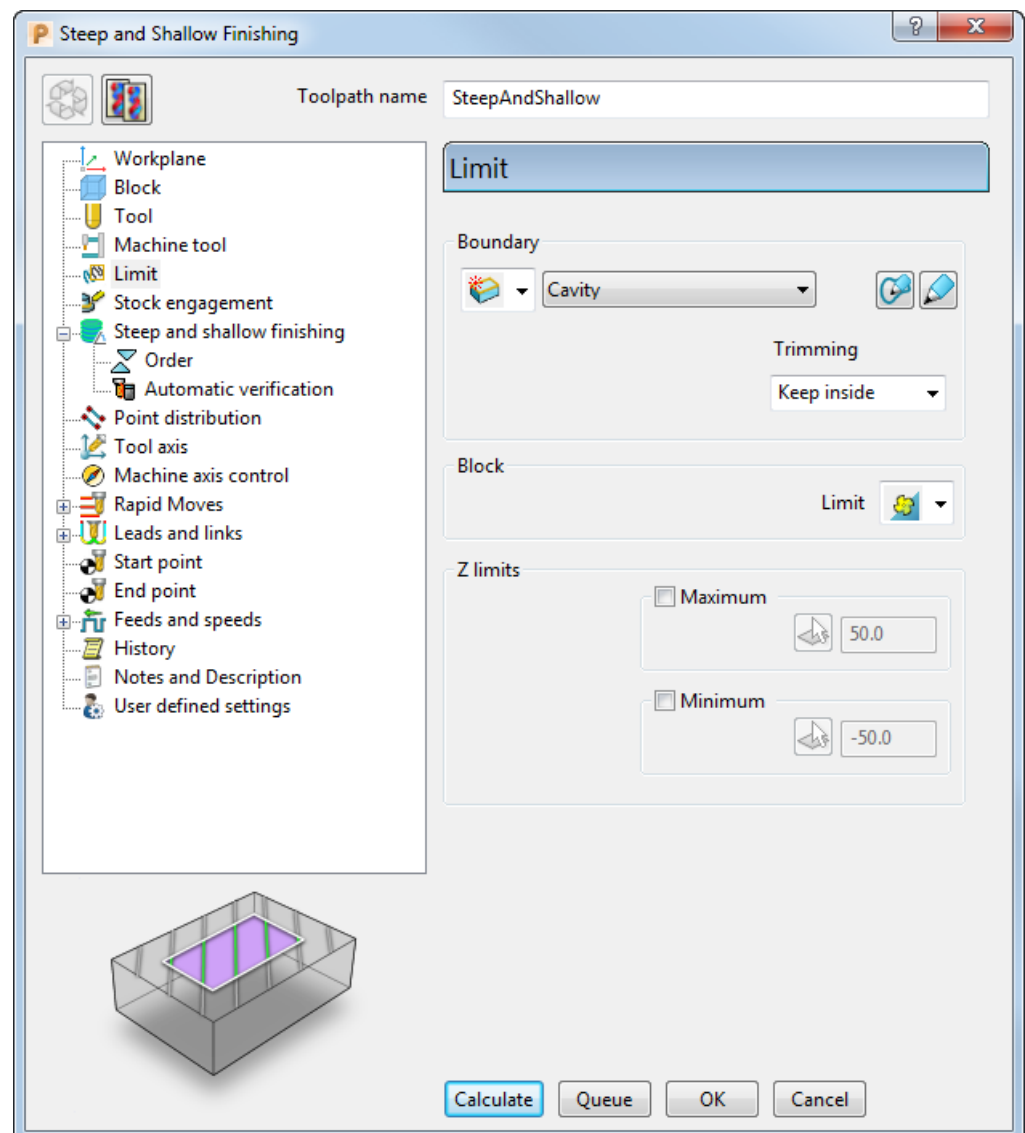
You now need to add the created boundary to the **Steep and Shallow Finishing** toolpath together with the appropriate leads and links.

- 1 In the Explorer, expand **Toolpaths** and select the **SteepAndShallow** toolpath.
- 2 Right-click and select **Settings** from the context menu.



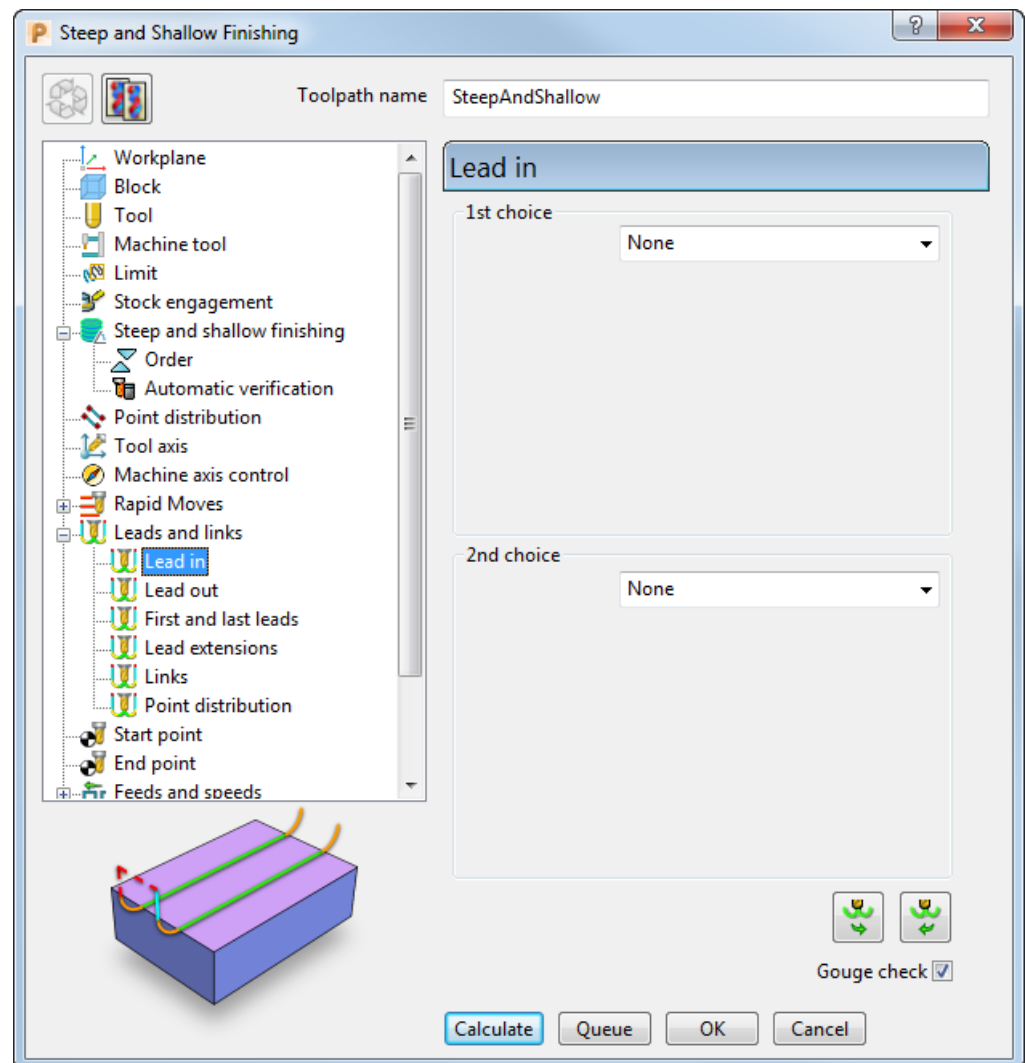
- 3 On the **Steep and Shallow Finishing** strategy dialog:
 - a Select the **Limit** page and:
From the **Boundary** list, select **Cavity**.

From the Trimming list, select **Keep inside**.



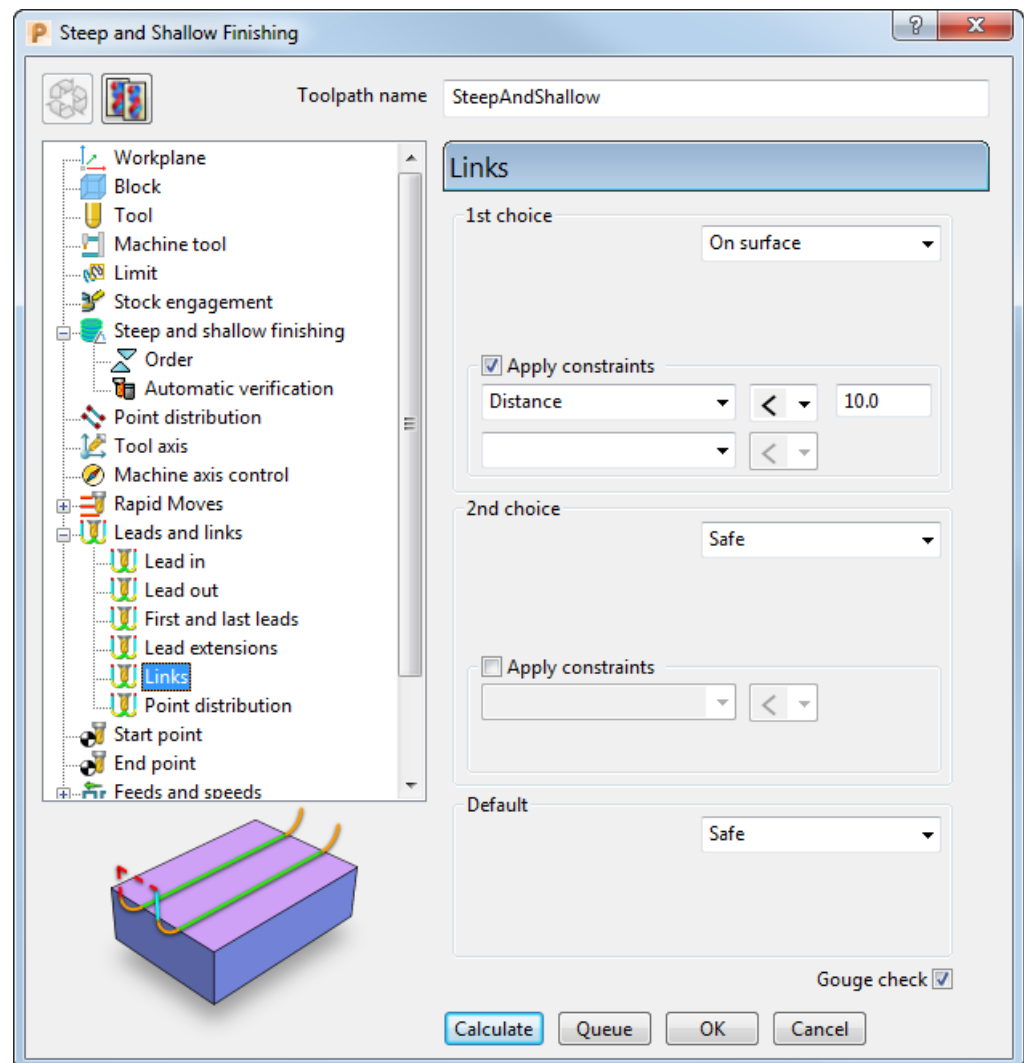
- b Expand the **Leads and Links** page, select the **Lead in** sub-page and:

In the **1st Choice** list, select **None**.



- c Select the **Links** sub-page to define link moves between the cutting moves in the toolpath and:

In the **1st choice** list, select **On surface** to define the type of link moves used to connect adjacent passes.



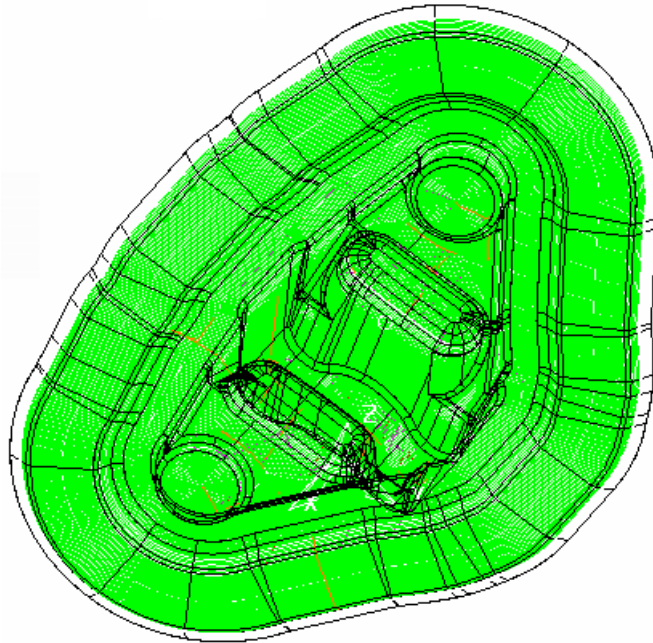
- 4 Click **Calculate** to generate the toolpath.

Progress is shown on the **Status** bar at the bottom of the screen. The generation may take a minute or so, depending on the processing power of your PC.

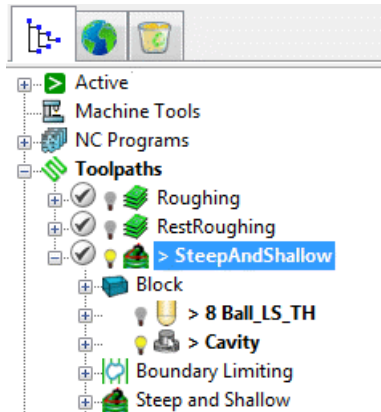
- 5 After the toolpath is generated, **Close** the strategy dialog.

Displaying the finishing toolpath

When the toolpath is generated, it is displayed on the screen:



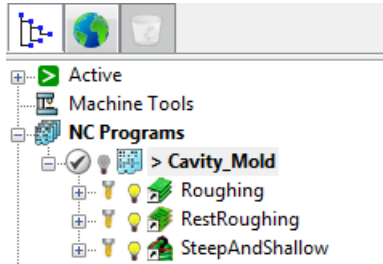
Click  to expand the **Toolpaths** branch in the Explorer. The new toolpath is shown in **bold** and preceded by the > symbol to indicate it's active.



To save project changes, click File tab > Save.

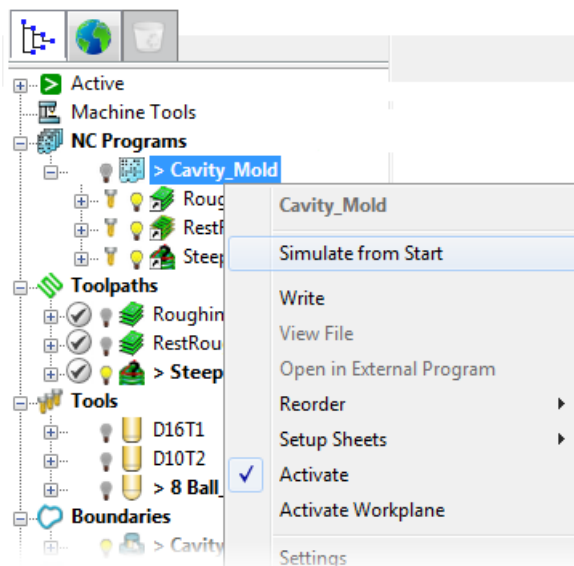
Simulating the NC program with generated toolpaths

The new toolpath is automatically added to the active NC program. If for some reason, your toolpath is not there, use the mouse to drag the toolpath under the NC program manually.



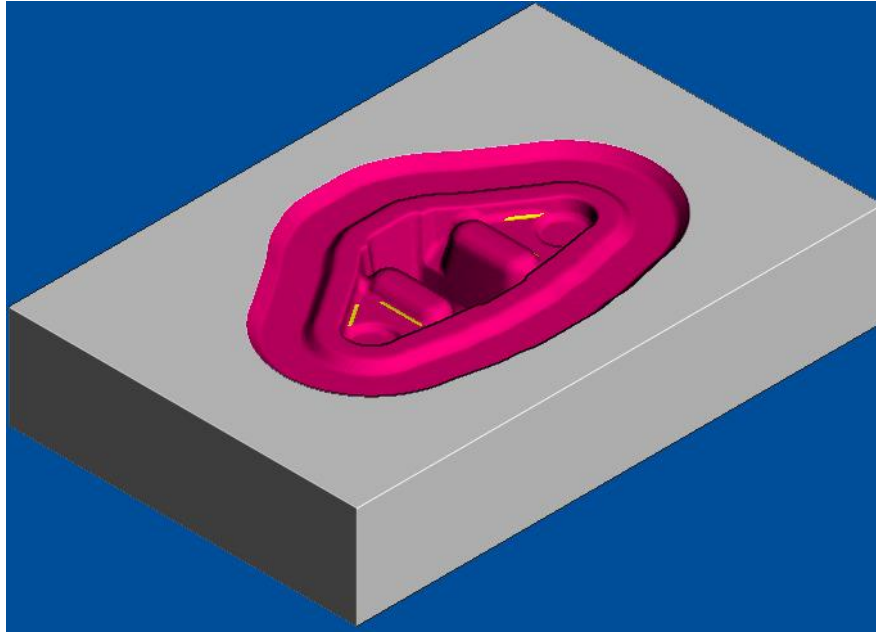
To simulate the NC program:

- 1 Click View tab > Views panel > ISO > ISO 1 to reset the view.
- 2 Click Simulation tab > ViewMill panel > Off. It turns green and changes to **On**.
- 3 To see the differences between toolpaths are more easily, click:
 - Simulation tab > ViewMill panel > Mode > Fixed direction.
 - Simulation tab > ViewMill panel > Shading > Rainbow.
- 4 In the Explorer, right-click the NC program **Cavity_Mold**, and select **Simulate from Start** from the context menu.

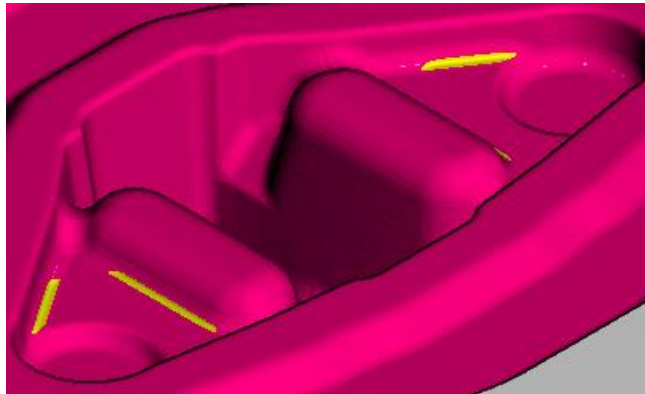


The NC program is automatically selected in in the Simulation tab > Simulation path panel > Entity list, and the Simulation Controls panel buttons are enabled.

- 5 Click Simulation tab > Simulation Controls panel > Play, and allow the simulation to run through to the end.



- 6 Zoom into the unmachined areas. You can see that some of the corners need cleaning up, especially between non-tangential surfaces.



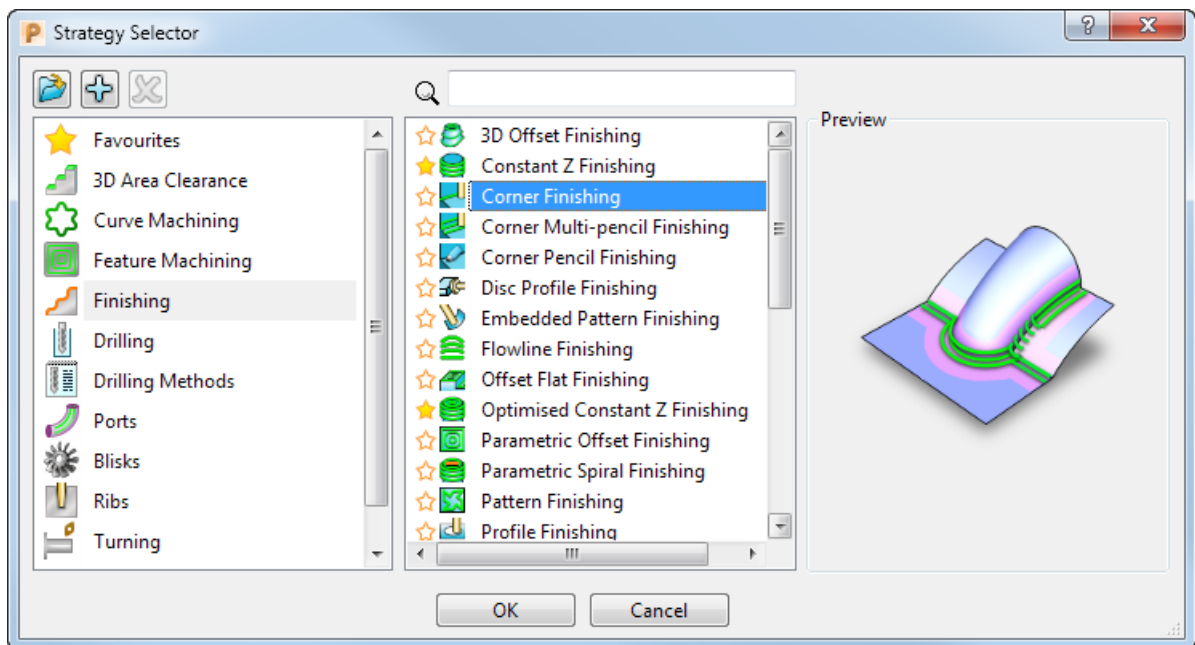
- 7 Click Simulation tab > ViewMill panel > Exit ViewMill, and select **Yes** to stop the simulation. The **On** button changes to **Off** and the standard PowerMill graphics window is displayed.

Creating the Corner Finishing toolpath

The **Corner Finishing** toolpath uses a smaller tool to machine the remaining corners, particularly between non-tangential surfaces.

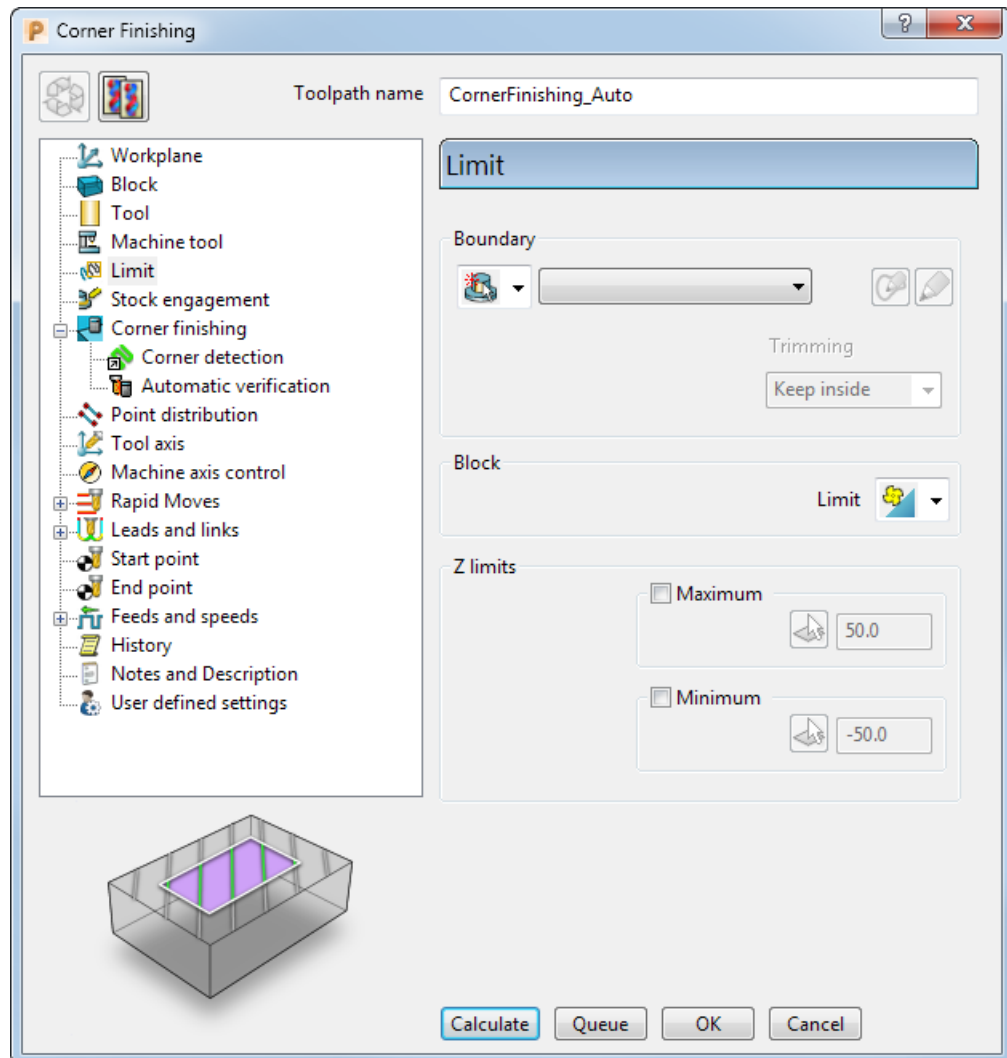
To create the Corner Finishing toolpath:

- 1 Click Home tab > Create Toolpaths panel > Toolpaths to display the **Strategy Selector** dialog.
- 2 Select the **Corner Finishing** strategy on the **Finishing** tab, and click **OK**.



- 3 In the **Corner Finishing** dialog:
 - a In the **Toolpath name** field, enter **CornerFinishing_Auto**.

- b Select the **Limit** page and choose **None** from the boundary list.

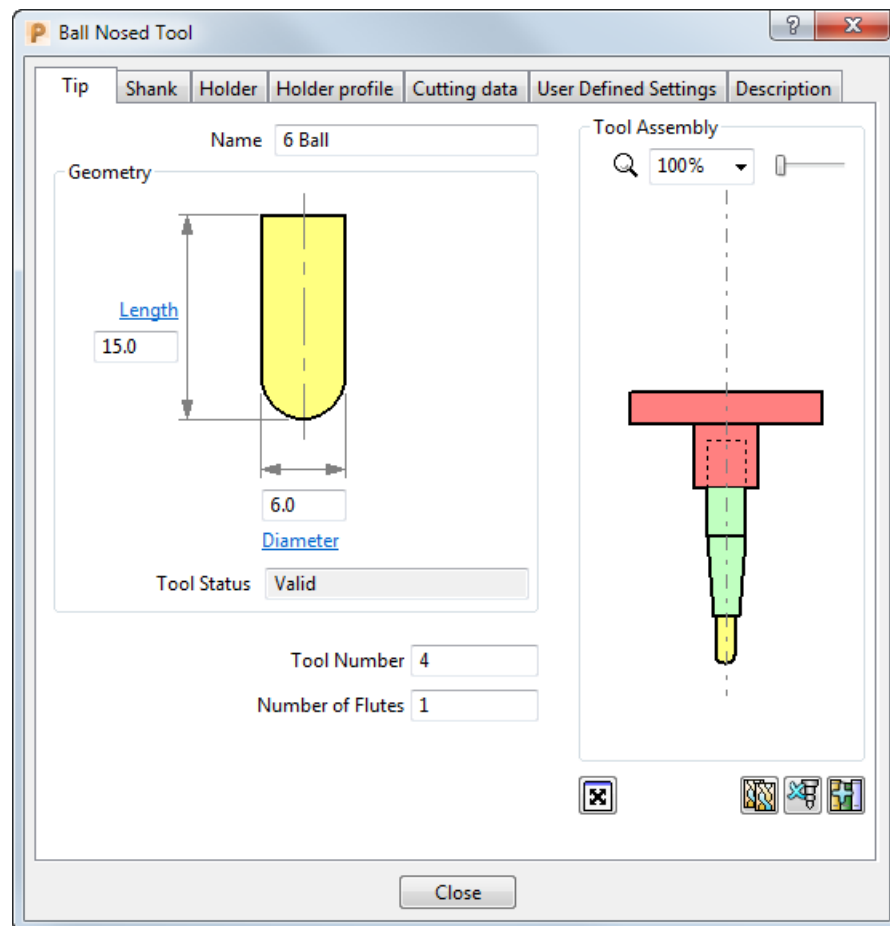


Defining the Corner Finishing tool geometry

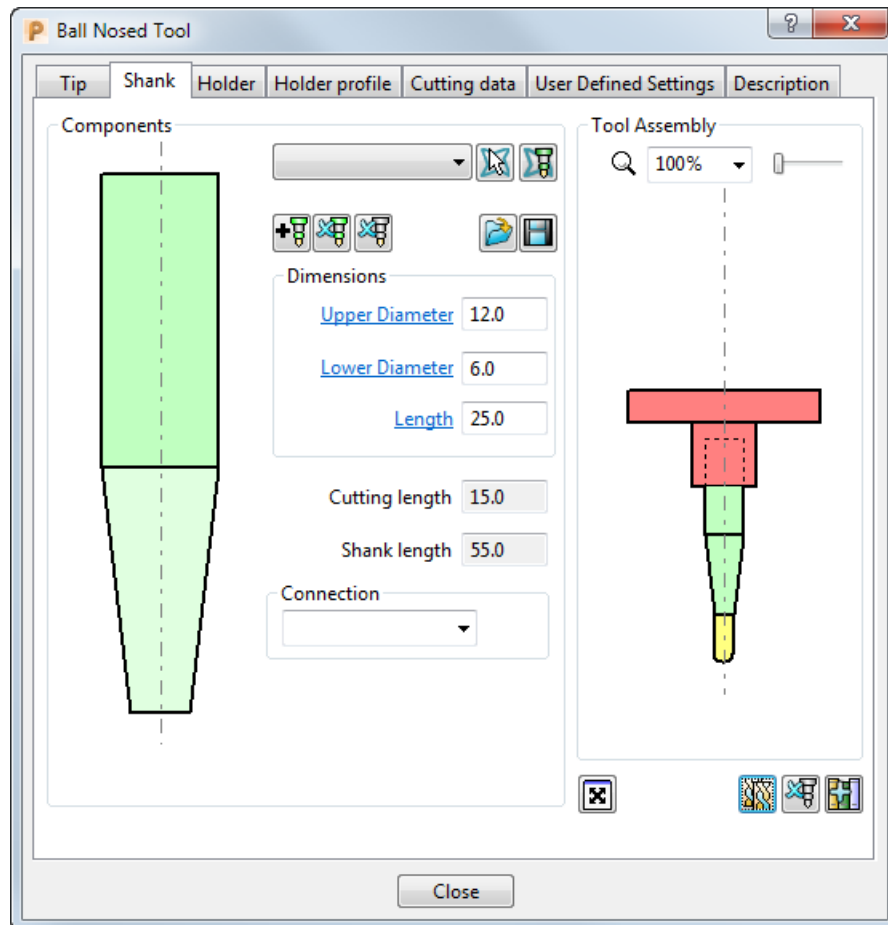
You can base the **Corner Finishing** tool on the tool used for the **SteepAndShallow** strategy, although it needs a smaller diameter. This example uses a 6 mm (1/8 inch) ball nosed tool.

- 1 Select the **Tool** page in the **Corner Finishing** dialog.
- 2 From the tool list, select **8 Ball_LS_TH**, and click the **Edit**  button.
- 3 In the **Ball Nosed Tool** dialog which appears, on the **Tip** tab, click  to create a new tool entity based on the existing tool. It is given the default name of **8 Ball_LS_TH_1**.
 - a Rename the tool to **6 Ball**.
 - b Enter a **Length** of **15** mm.
 - c Enter a **Diameter** of **6** mm.

d Enter the Tool Number as 4.



- 4 To adjust the shank to match the tip, select the **Shank** tab, click the bottom shank component (it turns pale green), and enter **6** in the **Lower Diameter** field.



- 5 You can leave the **Holder** as it is. Click **Close** to update the toolpath dialog with the new tool.



*The new tool is shown in the Explorer, and on the **Tool** tab, and it's also drawn in the graphics window, where it is automatically aligned with the Z axis.*

Completing and generating the Corner Finishing toolpath

In the **Corner Finishing** strategy dialog:

- 1 Select the **Corner finishing** page and:
 - a From the **Output** list, select **Both**. This creates two separate toolpaths for steep and shallow regions.
 - b Enter a **Threshold Angle** of **65**. This specifies the angle, measured from the horizontal, that determines the split between steep and shallow portions of the surface slope.

- c Enter a **Cusp** of **0.01**. This defines the maximum allowable cusp height. The stepover between tool passes is automatically calculated from this value and the geometry of the tool and part.
 - d From the **Cut direction** list, select **Any**. This uses both the **Climb** and **Conventional** methods of milling.
- 2 Select the **Corner detection** page and:
 - a Select **8 Ball_LS_TH** from the **Reference tool** list. The **Corner Finishing** toolpath makes a comparison between the current and previous tools, and automatically machines the corners that the previous tool was unable to access.
 - b Enter an **Overlap** of **0.5**. This indicates how far the toolpath is extended beyond the borders of the unmachined region. It is also used as the overlap value between the steep and shallow portions of the toolpath.
 - c Enter a **Detection limit** of **165**. This specifies the angle at which PowerMill finds corners. Only corners /less than the specified angle are machined.
- 3 Click **Calculate** to generate the toolpath.

Progress is shown on the **Status** bar at the bottom of the screen. The generation may take a minute or so, depending on the processing power of your PC.
- 4 After the toolpath is generated, **Close** the strategy dialog.

2 Select the **Corner detection** page and:

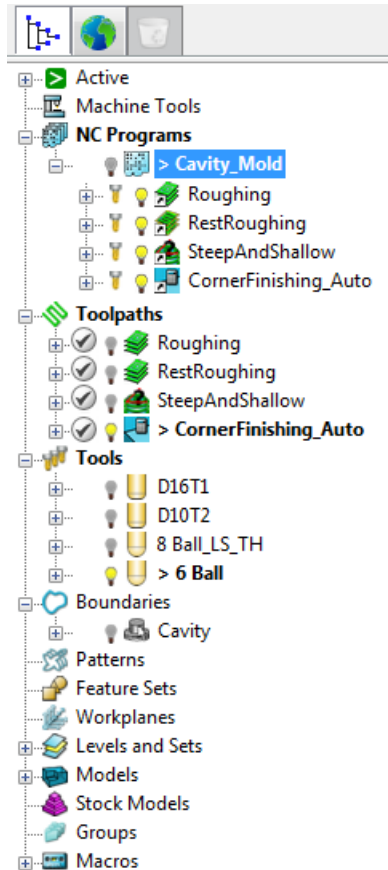
3 Click **Calculate** to generate the toolpath.

4 After the toolpath is generated, **Close** the strategy dialog.

When the toolpath is generated, it is displayed on the screen:

Click  to expand the **Toolpaths** branch in the Explorer. The new toolpath is shown in **bold** and preceded by the > symbol to indicate it's active.

If the NC program **Cavity_Mold** remains active, the toolpath is automatically added to it:

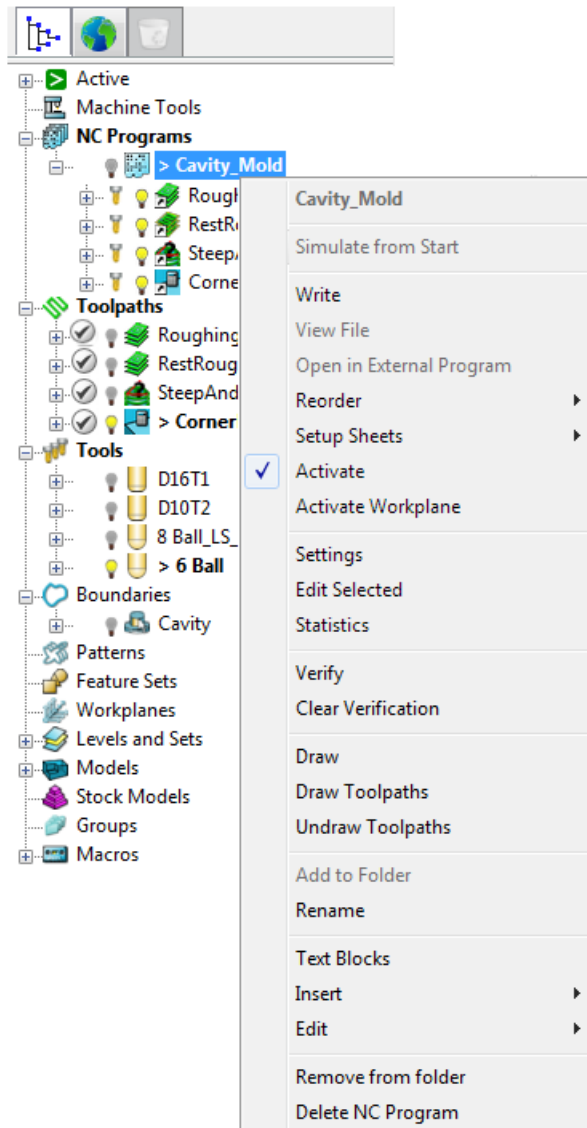


To save project changes, click File tab > Save.

Simulating the Corner finishing toolpath

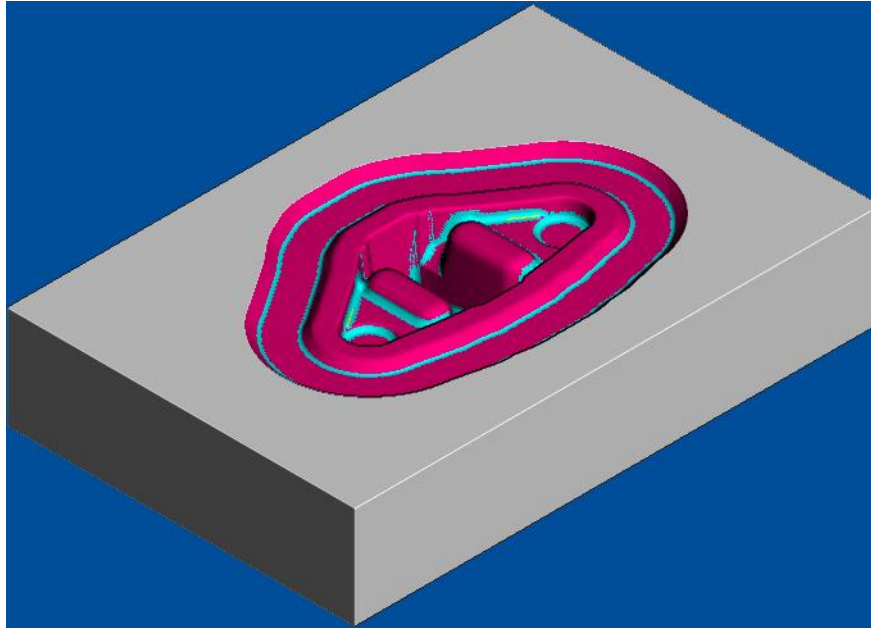
- 1 Click View tab > Views panel > ISO > ISO 1 to reset the view.
- 2 Click Simulation tab > ViewMill panel > Off. It turns green and changes to **On**.
- 3 To see the differences between toolpaths are more easily, click:
 - Simulation tab > ViewMill panel > Mode > Fixed direction.
 - Simulation tab > ViewMill panel > Shading > Rainbow.

- 4 In the Explorer, right-click the NC program **Cavity_Mold**, and select **Simulate from Start** from the context menu.

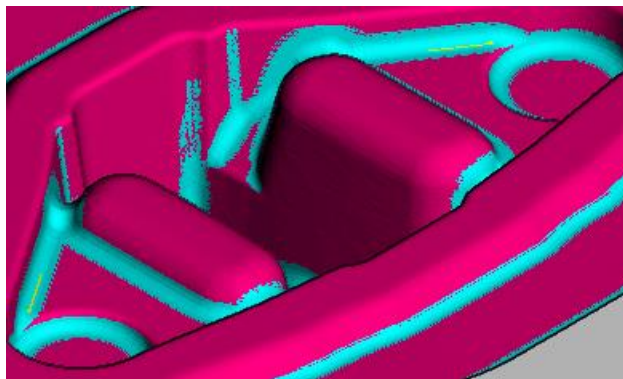


The NC program is automatically selected in in the Simulation tab > Simulation path panel > Entity list, and the Simulation Controls panel buttons are enabled.

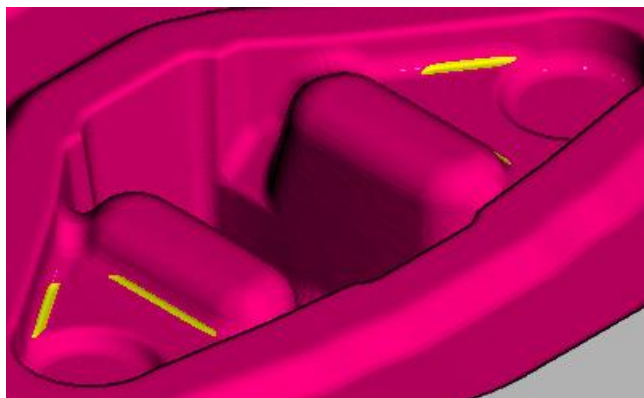
- 5 Click Simulation tab > Simulation Controls panel > Play, and allow the simulation to run through to the end.



- 6 Zoom into the machined areas to view the cleaning up of the non-tangential surfaces.



This compares the previous finishing toolpath which left some material in the corners.



- 7 Click Simulation tab > ViewMill panel > Exit ViewMill, and select **Yes** to stop the simulation. The **On** button changes to **Off** and the standard PowerMill graphics window is displayed.

Writing NC programs

When the toolpaths are generated, you can add them to an NC program to be postprocessed as an output file for a specific NC machine controller. Any number of toolpaths can be included and reordered, as required, depending on the limitations of the particular NC machine and the postprocessor.

By default, all toolpaths in an NC program are saved to a single NC program file. The following examples show you how to:

- Write each toolpath as a separate NC program file (see page 74).
- Write two NC program files (see page 76) with the toolpaths grouped by their functionality.

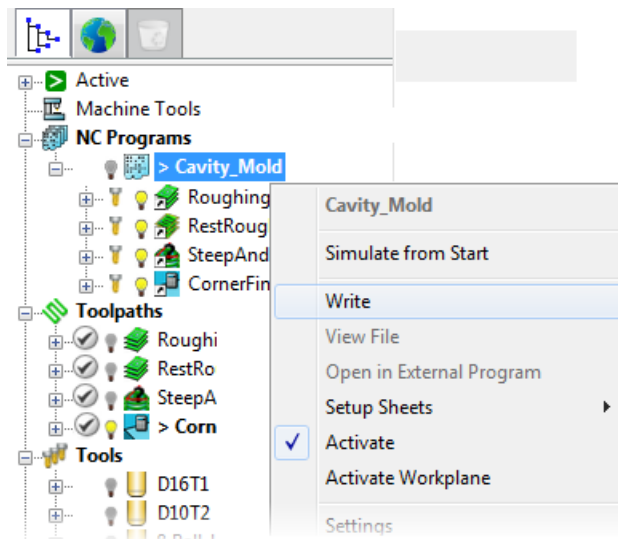
Writing each toolpath as a separate NC program file

This procedure shows how to generate separate NC program files for each toolpath in an NC program.



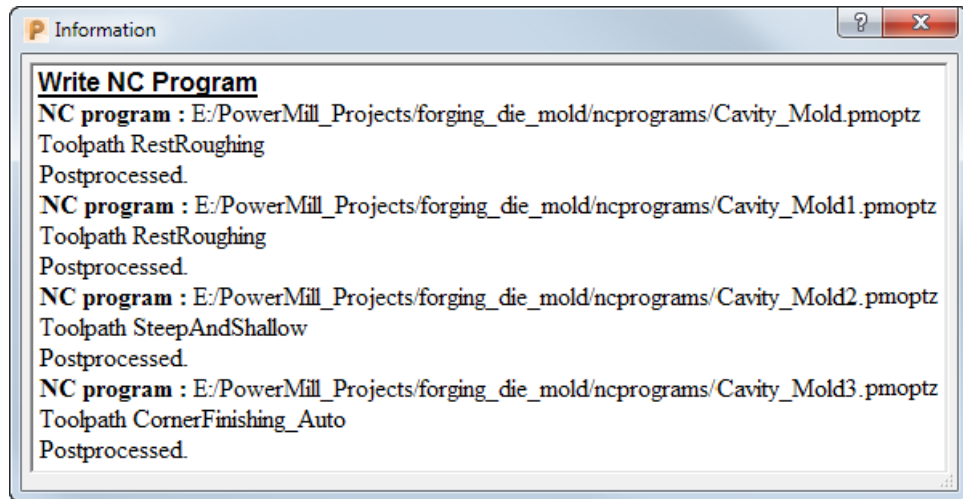
*To have separate NC program files for each of your toolpaths, the **Write File for Each Toolpath** option must be selected on File tab > Options > Application Options > NC Programs > Output.*

- 1 In the Explorer, right-click the NC program, **Cavity_Mold**, and select **Write** from the context menu.



The tool symbol  next to a toolpath indicates a tool change. It is always displayed for the first tool in the sequence. It is also displayed when a different tool is used.

- 2 PowerMill postprocesses the toolpaths using the specified parameters, and displays a confirmation window showing where the files are saved.

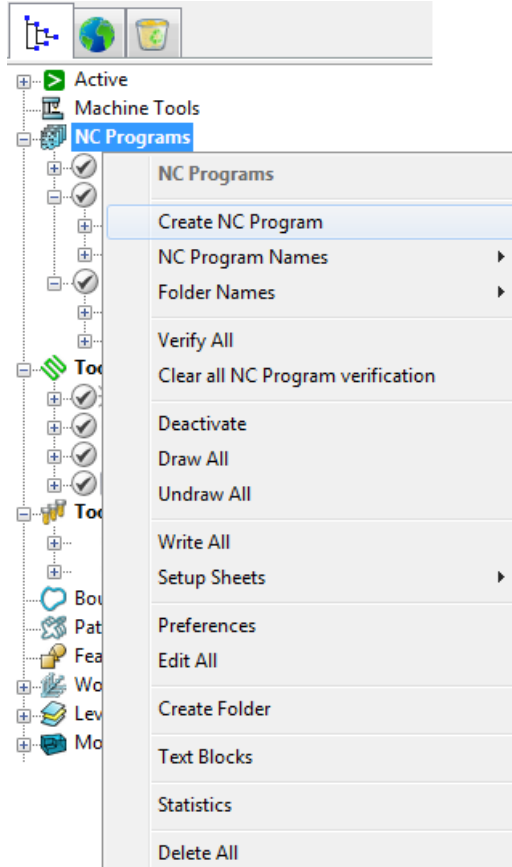


- 3 Click  to close the **Information** window.
- 4 The colour of the NC program **Cavity_Mold** in the Explorer changes to a bright green colour,  **Cavity_Mold**, to show it has been calculated correctly.
- 5 To save project changes, click File tab > Save.

Writing two NC program files

This example shows how to generate two NC program files, one with two roughing toolpaths, and another with the two finishing toolpaths.

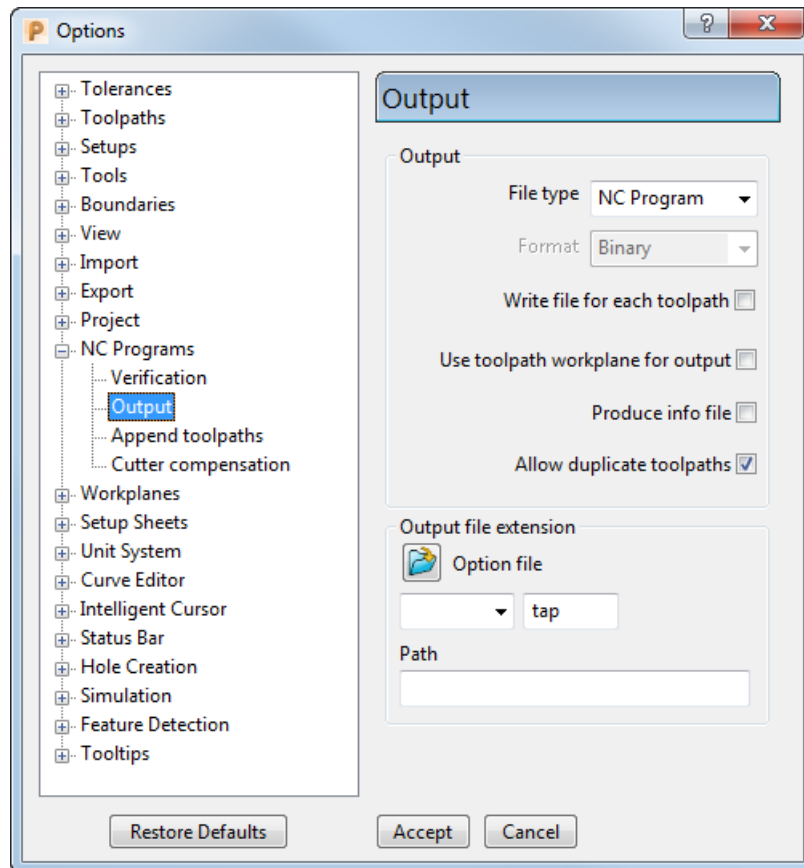
- 1 From the **NC Programs** context menu, select **Create NC Program**.



This displays the **NC Program** dialog.

- 2 In the **Name** field, enter **Cavity_Roughing**.
- 3 In the **NC Program** dialog, click the **Options**  button. The **Options** dialog is displayed.
- 4 On the **Output** tab:
 - a If selected, deselect the **Write File for Each Toolpath** option. As a result, the **Output File** is displayed at the top of the **NC Program** dialog instead of the **Root Name**.
 - b Select **Option File** as **heid400**.
 - c Enter **Output File Extension** as **tap**.

- d Click **Accept** to update and close the **Options** dialog.

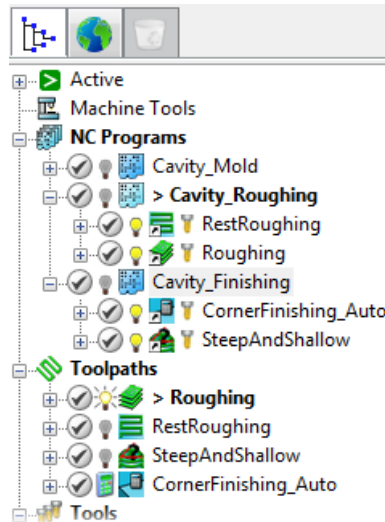


- 5 Click the **Accept** button at the bottom of the **NC Program** dialog to create a new roughing NC program.
- 6 From the individual NC Program, **Cavity_Roughing**, context menu, and select **Edit > Copy NC Program**.
- 7 A new entity is added to the **NC Programs** list with the default name of **Cavity_Roughing_1**. Right-click it and **Rename** it as **Cavity_Finishing**.

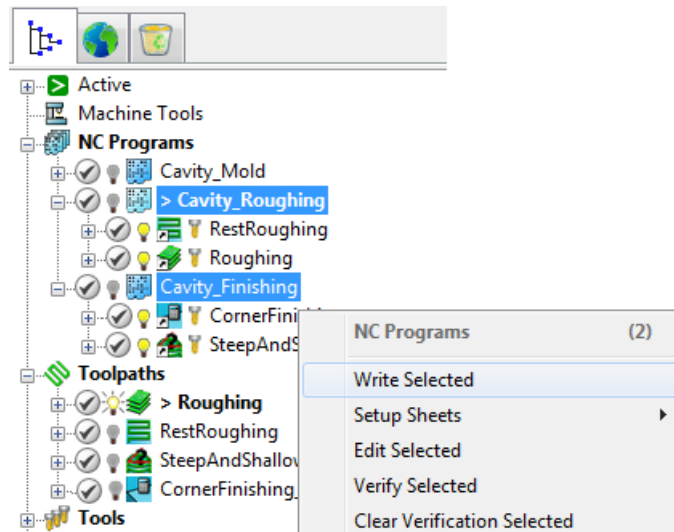


*To identify which NC program is currently active, expand the **NC Programs** node in the Explorer; the active program is shown in **bold** and preceded by the **>** symbol.*

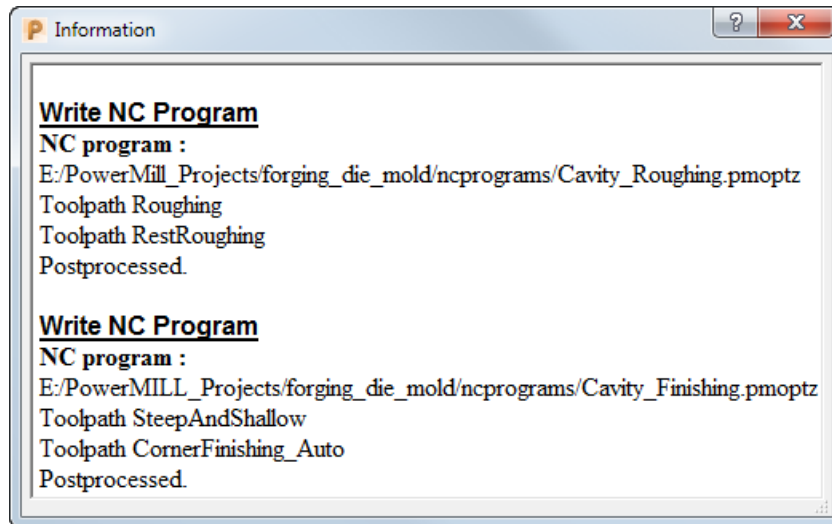
- 8 In the Explorer, move the two roughing toolpaths under **Cavity_Roughing**, and the two finishing toolpaths under **Cavity_Finishing**.



- 9 Select the **Cavity_Roughing** and **Cavity_Finishing** NC programs. Right-click and select **Write Selected**.



- 10 PowerMill postprocesses the NC programs using the specified parameters, and displays a confirmation window showing where the programs are saved.



*Two NC programs are written: **Cavity_Roughing.tap** containing both roughing toolpaths, and **Cavity_Finishing.tap** containing both finishing toolpaths.*

- 11 Click  to close the **Information** window.
- 12 To save project changes, click File tab > Save.

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